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BRIEF REPORT

Cognitive Control Deficits Associated With Antisocial Personality Disorder and Psychopathy

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Antisociality has been linked to a variety of executive functioning deficits, including poor cognitive control. Surprisingly, cognitive control deficits are rarely found in psychopathic individuals, despite their notoriously severe and persistent antisocial behavior. In fact, primary (low-anxious) psychopathic individuals display superior performance on cognitive control-type tasks under certain circumstances. To clarify these seemingly contradictory findings, we administered a response competition (i.e., flanker) task to incarcerated offenders, who were assessed for Antisocial Personality Disorder (APD) symptoms and psychopathy. As hypothesized, APD related to poorer accuracy, especially on incongruent trials. Contrary to expectation, however, the same pattern of results was found in psychopathy. Additional analyses indicated that these effects of APD and psychopathy were associated with overlapping variance. The findings suggest that psychopathy and APD symptoms are both associated with deficits in cognitive control, and that this deficit relates to general antisociality as opposed to a specific antisocial syndrome.

Keywords: antisociality, psychopathy, antisocial personality disorder, cognitive control, executive functioning

Identifying and exploring the risk factors and deficits that predispose individuals to antisocial behavior represents a critical step toward locating causal and potentially protective factors that relate to the expression or inhibition of inappropriate or illegal behavior. Investigations of antisociality frequently focus on two related constructs: Antisocial Personality Disorder (APD) and psychopathy. Antisociality Personality Disorder comprises a pattern of antisocial attitudes and behaviors (e.g., irresponsibility, impulsivity, irritability) that begin before the age of 15 (e.g., getting into fights, bullying, lying) and persist in adulthood (American Psychiatric Association, 2000). Psychopathy relates to a number of the same traits; however, individuals with psychopathy are also characterized by an arrogant and deceitful interpersonal style, callousness, and lack of emotionality (Hare, 2003). Psychopathy appears to have unique features that differentiate it from general criminality and Antisocial Personality Disorder, substance abuse, and other forms of disinhibitory psychopathology (Kosson, Lorenz, & Newman,

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2006; Patterson & Newman, 1993). Psychopathy is generally considered a more severe syndrome of antisociality than APD; thus, while about 75% of prison inmates meet criteria for APD, only about 15–25% meet criteria for psychopathy (Hare, 1996).

A primary focus of research on the causes of antisocial behavior relates to impaired executive functioning (EF), which Morgan and Lilienfeld (2000) define as an "umbrella term that refers to the cognitive processes that allow for future, goal-oriented behavior" (p. 114). According to this model, people with executive functioning deficits are less able to override maladaptive response inclinations in order to maintain more appropriate and personally beneficial behavior. Consequently, they are at high risk for persistent rule breaking and committing acts of violence. Consistent with this model, the antisocial syndromes examined by the authors displayed EF deficits in multiple domains.

Although the association between EF deficits and antisociality is promising, both EF and antisociality are general terms that encompass diverse processes (e.g., cognitive control, planning) and subtypes (e.g., psychopathy and APD), respectively. Thus, the overall association between antisociality and EF functioning may mask the fact that different antisocial subtypes are characterized by distinct EF deficits. Moreover, this concern may be especially important for the cognitive control component of EF. Cognitive control refers to the ability to persist in goal-directed behavior in the face of competing cognitive and behavioral demands and is a crucial component of self-regulation (MacCoon, Wallace, & Newman, 2004). Despite the general association between antisocial syndromes and EF deficits (Morgan & Lilienfeld, 2000; see also Blair, 2001), psychopathic individuals generally do not display deficits on cognitive control tasks (Blair et al., 2006; Brinkley, Schmitt, & Newman, 2005; Dvorak-Bertsch, Sadeh, Glass, Thornton, & Newman, 2007; Hart, Forth, & Hare, 1990; Hiatt, Schmitt, & Newman, 2004; Munro, Dywan, Harris, McKee, Unsal, & Segalowitz, 2007; Smith, Arnett, & Newman, 1992; Sutker, Moan, & Allain, 1983). Thus, despite the high level of antisocial behavior displayed by psychopathic individuals, they do not appear to manifest deficits in cognitive control.

Furthermore, there is evidence that, under certain circumstances, psychopathic individuals display superior performance on cognitive control tasks (Hiatt et al., 2004). This does not reflect the presence of more efficient basic cognitive control processes in psychopathy. According to Hiatt et al. (2004), the reduced interference displayed by psychopathic individuals on such tasks reflects the fact that they are generally insensitive to peripheral information once they establish a goal-directed focus of attention. Newman and colleagues (e.g., Newman & Lorenz, 2003) have proposed a response modulation theory to account for the insensitivity to peripheral information associated with psychopathy. Moreover, this pattern appears specific to "primary psychopathy"–individuals who, in keeping with the classic clinical description of the disorder, have low levels of anxiety combined with high levels of psychopathy (Cleckley, 1976). Across diverse paradigms, individuals with primary psychopathy display an abnormality in early selective attention that often precludes the conscious representation of information that conflicts with their goal-directed behavior (Hiatt & Newman, 2006). Of specific importance to this study, to the extent that this abnormality in early selection reduces perception of peripheral distractions (e.g., response conflict), it would obviate the need to use late selection or cognitive control to inhibit the distracting information (Lavie, 2005).

The goal of the current study is to clarify the apparent inconsistencies in responsivity to response incongruent distracters associated with different antisocial syndromes. More specifically, this study seeks to distinguish the cognitive control deficit associated with APD from the early selective attention abnormality apparent in psychopathy (and primary psychopathy). An examination of these different individual difference variables, within the same sample, will allow us to explore the hypothesis that these constructs, while related to similar patterns of behavior (e.g., criminality), reflect unique cognitive underpinnings. Further, given that antisociality is inherent to both psychopathy and APD, this strategy affords the opportunity to examine the unique versus shared (i.e., overlapping) contributions of psychopathy and APD to executive control.

To this end, we administered a flanker task (Eriksen & Eriksen, 1974), in which centrally presented target stimuli were flanked on either side by distracter stimuli. In a flanker task, the distracter stimuli may be associated with the same response as the target stimuli, a different response than the target stimuli, or with no particular response. When distracter stimuli are incongruent with target stimuli, participants reliably respond more slowly and less accurately (i.e., display greater interference) than when distracters are congruent or unrelated to the target stimuli. Owing to these features, the flanker task, like the Stroop task, is regarded as a classic test of cognitive control (Botvinick, Braver, Barch, Carter, & Cohen, 2001).

To evaluate the differential association between cognitive control and antisociality versus psychopathy, we propose a series of analytic steps. After analyzing the effects of the task independent of personality variables, we first focus on APD-related effects. Given the association between APD and deficient cognitive control (Morgan & Lilienfeld, 2000), we predict that APD symptoms will be positively associated with interference (i.e., poorer cognitive control) on the flanker task. Interference is assessed using an "incongruency contrast," comparing the reaction time or accuracy for trials with incongruent distracters to trials without incongruent information.

Next, we investigate psychopathy-related effects on task performance. Because psychopathy is generally unrelated to cognitive control deficits, including those associated with flanker task performance (e.g., Munro et al., 2007), we predict that psychopathy will be unrelated to interference in this study. In order to replicate the analytic strategies of our prior studies of selective attention anomalies in psychopathy, our analyses compare primary (low-anxious) psychopathic individuals to nonpsychopathic individuals at a comparable anxiety level and we treat psychopathy and anxiety as dichotomous variables. Nevertheless, because psychopathy is commonly conceptualized as a continuous variable, we also report results for psychopathy and its subfactors using continuous analyses. Finally, we investigate the unique and overlapping variance of psychopathy and APD. These analyses allow us to explore whether our findings for the study are unique to a specific form of externalizing psychopathology (APD or psychopathy) or, instead, reflect a more general deficit that is common to these disorders.

Method

Participants

Participants consisted of 126 incarcerated Caucasian males in a maximum security correctional institution in Wisconsin, who met our basic inclusion criteria for participation; that is, participants had to be 45 years old or younger, free of any history of psychosis or bipolar disorder, and not currently taking psychotropic medication. Also, only participants scoring 70 or higher on a brief intelligence questionnaire (Zachary, 1986) were included the study. In addition, one outlier (identified using studentized residuals of the incongruency contrast for both reaction time and accuracy, with Bonferroni corrected p values $<.05$) was excluded from analyses. For this experiment, participants' ages ranged from 18 to 45, with a mean of 28.25 ($SD = 7.68$). Estimated IQ scores ranged from 70.59 to 122.59, with a mean of 98.48 ($SD = 11.47$). Participants' scores on the Welsh Anxiety Scale (Welsh, 1956) ranged from 0 to 34, with a mean of 11.91 ($SD = 9.25$).

All participants were assessed for psychopathy using the Psychopathy Checklist−Revised (PCL-R: Hare, 2003). This measure uses information gleaned from an interview and a review of institutional files to score the participant on the presence of 20 different items. Offenders were paid $8 for their participation in this interview. Scores on this measure ranged from 4.40 to 37.90, with a mean of 24.50 ($SD = 7.68$). In this sample, Cronbach's alpha for the PCL-R total score was .82 (for 45 participants with no items omitted). Seven participants had two PCL-R raters; interrater reliability for this subset of scores was .95.

Participants were also assessed for APD symptoms during the same interview and file review that was used for the PCL-R assessment with the addition of specific questions about the presence of a variety of antisocial behaviors (e.g., burglary, physical cruelty to animals, vandalism, etc.) before age 15 to assess Conduct Disorder symptoms. The average number of APD symptoms in this sample was 9.06 ($SD = 4.27$) and scores on this measure (i.e.,

number of symptoms met) ranged from 1 to 20. Cronbach's alpha for the APD total score was .82. Seven participants had two APD raters; interrater reliability for this subset of scores was .95.

In addition, participants completed the Welsh Anxiety Scale (Welsh, 1956) to distinguish between primary and secondary psychopathy (see Newman & Brinkley, 1997; Newman, MacCoon, Vaughn, & Sadeh, 2005), as previous research suggests that the response modulation deficits of psychopathic offenders may be specific to primary psychopathic individuals (i.e., those with low vs. high levels of anxiety).

As in previous research, participants scoring 20 or lower on the PCL-R were considered nonpsychopathic ($n = 44$), and participants scoring 30 or higher were considered to be psychopathic ($n = 54$). Participants were divided into low-anxious and high-anxious group using a median split (9) on the Welsh Anxiety Scale (Welsh, 1956). This resulted in 52 participants considered to be low-anxious, and 46 participants considered to be high-anxious. Ultimately, then, the sample can be considered as being divided into four groups: (a) low-anxious psychopathic ($n = 29$), (b) low-anxious nonpsychopathic ($n = 23$), (c) high-anxious psychopathic ($n = 25$), and (d) high-anxious nonpsychopathic ($n = 29$) participants. There was no difference in anxiety scores between the psychopathic and nonpsychopathic groups, and no difference in PCL-R scores between the low and high anxious groups.

Apparatus

The flanker task was presented on a PC with a 16 in. monitor, and was programmed in Micro-Experimental Laboratory (Schneider, 1988) software. Participants' eyes were roughly 30 cm from the screen. Responses were entered on a keyboard; no feedback was given during the task.

Procedure

Each participant completed one testing session of 600 test trials, divided into five blocks of 120 trials each. For each trial, a fixation point (+) appeared for 500 milliseconds. After this, the target and flankers appeared and remained on the screen until the participant entered a response. The target appeared at fixation and the two distracters appeared to the left and right, equidistant from the target (approximately one degree of visual angle). The target stimulus was always a 5, 8, G, or M. The distracters were always one of these stimuli or a pound sign (#). Participants entered a response indicating whether the target was a letter or a number. This was followed by a 1000–1500 millisecond variable intertrial interval.

There were three main types of trials in this task. Congruent trials were those in which the target and distracters were of the same type (e.g., 8 5 8), incongruent trials were those in which the target and distractors were of different types (e.g., G 5 G), and control trials were those in which the distracters were pound signs (e.g., # 5 #). The primary dependent measures were accuracy and reaction time scores for incongruent, congruent, and control trials. Trials in which participants took less than 100 milliseconds or more than 1500 milliseconds to respond were not included in the reaction time analyses. Participants were paid $3 for completing this particular task.

Results

Preliminary/Task Effect Analyses

Prior to analyses of individual differences, analyses were performed to examine the effect of trial type (i.e., congruent, control, incongruent) on accuracy and reaction time. Reaction time and accuracy measures were analyzed separately in General Linear Models with Trial Type as a categorical repeated measures factor. Condition effects were parsed into two planned contrasts, an incongruency effect contrast (incongruent vs. congruent/control) and a facilitation contrast (congruent vs. control). For reaction time, there was a significant effect of trial type, $F(2, 250) = 283.15$, $p < .01$, $\eta_p^2 = .69$. The incongruency contrast revealed that participants were significantly faster on the control/congruent trials ($M = 579$, $SD = 92$) than incongruent trials ($M = 610$, $SD = 93$), $F(1, 125) = 455.21$, $p < .01$, $\eta_p^2 = .79$. The facilitation contrast was not significant, $F(1, 125) = 1.08$, $p = .30$, $\eta_p^2 = .01$. For accuracy, again there was a significant effect of trial type, $F(2, 250) = 31.97$, $p < .01$, $\eta_p^2 = .20$. The

incongruency contrast revealed that participants were significantly more accurate on the control/congruent trials ($M = 97.9\%$, $SD = 1.8\%$) than incongruent trials ($M = 97.0\%$, $SD = 2.5\%$), $F(1, 125) = 44.30$, $p < .01$, $\eta_p^2 = .26$. The facilitation contrast revealed that participants were significantly more accurate on the congruent trials ($M = 98.1\%$, $SD = 1.9\%$) than the control trials ($M = 97.8\%$, $SD = 1.9\%$), $F(1, 125) = 7.84$, $p = .006$, $\eta_p^2 = .059$.

Antisocial Personality Disorder (APD) Symptoms Analyses

These analyses focused on the prediction that antisocial behavior would be related to greater interference from inhibitory information, as reflected by lower accuracy and/or slower response times for trials with incongruent distracters compared to the other trial types. Reaction time and accuracy measures were analyzed separately in General Linear Models with Trial Type (incongruent, congruent, or control) as a categorical repeated measures factor and Antisocial Personality Disorder symptoms as both a continuous variable and a dichotomous variable (in separate analyses). As above, condition effects were parsed into two planned contrasts, an incongruency effect contrast and a facilitation contrast.

For reaction time, there were no significant main or contrast effects for APD symptoms continuously or dichotomously. However, analysis of the accuracy data revealed a significant main effect for APD symptoms continuously, $F(1, 124) = 8.64$, $p = .004$. This main effect was qualified by a significant interaction between APD symptoms and trial type, $F(2, 248) = 5.50$, $p = .006$. The nature of this interaction is clarified by the significant APD symptoms by incongruency contrast interaction, $F(1, 124) = 7.92$, $p = .006$. Specifically, APD symptoms were related to significantly greater interference (i.e., worse performance) in incongruent trials relative to other trials (see Figure 1). When analyzed dichotomously, there was a trend level main effect for APD, $F(1, 124) = 3.62$, $p = .06$. This main effect was qualified by a significant interaction between APD symptoms and trial type, $F(2, 248) = 4.41$, $p = .01$. The nature of this interaction is clarified by the significant APD symptoms by incongruency contrast interaction, $F(1, 124) = 6.54$, $p = .01$. As with the continuous analyses, these results reflect that antisociality was related to lower accuracy on incongruent trials.

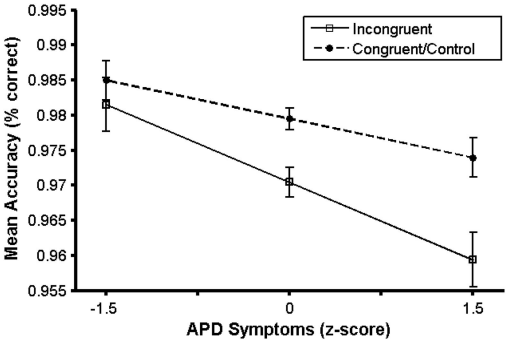

Figure 1. Incongruency effect by APD symptoms. The relationship between APD symptoms and accuracy was moderated by Trial Type. APD symptoms were significantly inversely related to accuracy in all conditions, but individuals high on APD symptoms had significantly worse accuracy on the incongruent trials as compared to the other trials. Accuracy means displayed for low and high APD symptoms were calculated at 1.5 standard deviations below and above the sample mean on APD symptoms, respectively. Error bars represent the standard error for the point estimate.

Psychopathy Analyses

The following analyses were focused on testing the predictions for psychopathy (no differences in interference), as well as for primary (i.e., low-anxious) psychopathic individuals (no difference or less interference). Reaction time and accuracy measures were analyzed separately in General Linear Models with Trial Type (incongruent, congruent, or control) as a categorical repeated measures factor and Psychopathy Group (Nonpsychopathic or Psychopathic) and Anxiety Group (Low-Anxious or High-Anxious) as categorical between-subjects factors. As above, condition effects were parsed into two planned contrasts, an incongruency effect contrast and a facilitation contrast.

There were no differences due to psychopathy, anxiety, or their interaction detected in the reaction time analysis. In addition, we conducted a planned comparison that focused on low-anxious offenders to examine the effects of primary psychopathy on performance. However, consistent with the overall analyses, there

were no significant effects associated with primary psychopathy.

For accuracy there was a significant interaction between psychopathy group and the incongruency contrast, $F(1, 94) = 5.23$, $p = .02$, with psychopathic participants displaying greater interference (i.e., 1.2% lower accuracy) than nonpsychopathic participants (i.e., .4% lower accuracy) on incongruent versus other trials. There was no difference in accuracy between the congruent and control trial types. Mean reaction time and accuracy data for the different subject groups and experimental conditions are presented in Table 1.

The planned comparisons involving low-anxious psychopathic and nonpsychopathic participants revealed a significant main effect for psychopathy, $F(1, 50) = 6.96$, $p = .01$, with psychopathic participants ($M = 97.5\%$, $SD = 2.3\%$) displaying significantly lower accuracy than nonpsychopathic participants ($M = 98.2\%$, $SD = 1.2\%$) across all trial types. However, there were no significant psychopathy-related effects for either contrast within low-anxious participants.

The above analyses were performed to replicate the analytic strategies of previous studies on selective attention deficits in psychopathy. However, we also re-examined the psychopathy X anxiety analysis, using both variables continuously as opposed to categorically. As before, there were no main effects of interactions of psychopathy or anxiety for any of the reaction time measures. For accuracy, there was a significant interaction between psychopathy and the incongruency contrast, $F(1, 122) = 3.89$, $p = .05$, similar to the group effect above. There were also significant main effects for psychopathy, $F(1, 122) = 10.97$, $p = .001$, and anxiety, $F(1, 122) = 6.02$, $p = .02$, with higher scores related to lower accuracy for both variables. There was also a significant psychopathy by anxiety interaction for overall accuracy $F(1, 122) = 7.37$, $p = .01$, indicating that the negative association between psychopathy and accuracy was strongest when anxiety levels are relatively low.

Subsequent analyses were performed to investigate the relationship of the two, three, and four factor models of psychopathy with performance on the current task (limited to accuracy, as no reaction time effects were found for this task). For the two-factor model, there was a significant main effect of Factor 2 ($n = 116$), such that high Factor 2 scores were related to lower overall accuracy, $F(1, 114) = 7.27$, $p = .01$. There was also a trend for a significant interaction between psychopathy Factor 2 and the incongruency contrast, $F(1, 114) = 3.48$, $p = .07$; this suggests that, while Factor 2 scores were related to poorer accuracy overall, this effect was most prominent for the incongruent trials.

For the three factor model ($n = 110$), there was a trend for a main effect of facet 3, $F(1, 106) = 3.50$, $p = .06$, such that facet 3 appears to have a modest negative relationship with overall accuracy. None of the other main effects or interactions with the facets approached significance. There were no unique main effects or interactions of the facets in the four facet model.[1]

Unique Versus Overlapping Effects of Psychopathy and APD Symptoms

Additional analyses examined the differential effects of PCL-R scores and APD symptoms on accuracy. An analysis like the primary analyses presented above was performed, including both PCL-R total score and number of APD symptoms as continuous variables (mean centered and standardized). When APD symptoms and PCL-R scores were entered simultaneously to examine the unique effects of these constructs, only the relationship between APD symptoms and overall accuracy (i.e., main effect) remained significant, $F(1, 123) = 5.11$, $p = .025$. In addition, there was a trend-level effect for the APD symptoms by incongruency contrast interaction ($p = .08$). APD was not significantly related to the facilitation contrast. Finally, none of the unique effects of PCL-R score on performance approached significance.

[1] Analyses with IQ included as a covariate were also performed, to see if the aforementioned effects remained. There was no significant relationship of IQ and overall reaction time, $F(1, 93) = 0.36$, $p = .55$, and no interaction of IQ and the incongruency ($F(1, 93)<0.01$, $p = .96$) or facilitation, $F(1, 93) = 0.66$, $p = .42$ contrasts. There was a significant main effect of IQ on overall accuracy, $F(1, 93) = 4.34$, $p = .04$. There was no significant interaction of IQ and the incongruency, $F(1, 93) = 0.81$, $p = .37$ or facilitation, $F(1, 93) = 0.05$, $p = .83$ contrasts. Including these as covariates, for both the accuracy and reaction time analyses, did not substantially change any of the other main effects or interactions presented in the main analyses.

Table 1
Mean Reaction Times, Accuracy Scores, and Standard Deviations for the Flanker Task by Level of Psychopathy and Anxiety

	Low-anxious				High-anxious			
	Nonpsychopathic (n = 23)		Psychopathic (n = 29)		Nonpsychopathic (n = 21)		Psychopathic (n = 25)	
Trial type	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Reaction Time								
Congruent	579	96	575	87	580	74	563	72
Control	580	97	576	87	577	70	563	78
Incongruent	612	105	607	84	603	68	595	74
Accuracy								
Congruent	98.9%	1.0%	97.5%	2.4%	98.0%	1.5%	98.6%	1.8%
Control	98.5%	1.3%	97.4%	2.0%	97.9%	1.7%	98.3%	1.8%
Incongruent	98.1%	1.6%	96.3%	3.1%	97.5%	1.1%	97.3%	3.1%

Discussion

The results of this study provided support for our primary hypothesis that a deficit in cognitive control, as measured by the Eriksen flanker task, would be positively and significantly associated with symptoms of antisocial behavior. More specifically, we found that increasing levels of APD symptoms were associated with a greater number of incorrect responses, particularly on those trials containing response incongruent information. In light of the fact that these trials require inhibiting the incorrect response activated by the flanker stimuli, this finding provides good support for Morgan and Lilienfeld's (2000) conclusions regarding the importance of inhibitory deficits in syndromes characterized by antisocial behavior. This finding is also consistent with the proposal that deficits in cognitive and inhibitory control are important risk factors predisposing individuals to a chronic antisocial lifestyle (Hughes, White, Sharpen, & Dunn, 2000; Kooijmans, Scheres, & Oosterlaan, 2000; Muris, Meesters, & Blijlevens, 2007; Raaijmakers et al., 2008). Likewise, the ability to inhibit prepotent responses to contextual cues in order to maintain one's goal-directed behavior is commonly regarded as a core skill needed to inhibit punished responses (Geier & Luna, 2009), delay gratification (Olson, Schilling, & Bates, 1999; Rueda, Acosta, & Santonja, 2007), tolerate frustration (McDonald, 2008), abstain from drug use (Fillmore & Rush, 2002; Goldstein & Volkow, 2002; Ivanov, Schulz, Londo, & Newcorn, 2008; Jentsch & Taylor, 1999; Kaufman, Ross, Stein, & Garavan, 2003; Volkow, Fowler, & Wang, 2004), and overcome aggressive urges (Albert & Chew, 1980; Oosterlaan & Sergeant, 1996; Raaijmakers et al., 2008; Sterzer & Stadler, 2009; Valzelli, 1984).

Although psychopathy is significantly associated with antisocial behavior, previous research using cognitive control tasks with psychopathic offenders (Dvorak-Bertsch et al., 2007; Munro et al., 2007) led us to predict that psychopathy would not be associated with poor performance in the current study. Contrary to expectation, psychopathic participants were also significantly more likely than controls to commit errors on incongruent trials regardless of level of anxiety (i.e., primary vs. secondary psychopathy). This finding suggests that the inhibitory deficit observed in this study is associated with a general "antisociality dimension" that cuts across psychopathy and other antisocial syndromes. This conclusion was further substantiated by statistical analyses which found that errors on incongruent trials were related to the variance shared by psychopathy scores and APD symptoms.

These unexpected findings for psychopathy appear inconsistent with other published reports that found no evidence of cognitive control deficits in psychopathic offenders (Dvorak-Bertsch et al., 2007; Hiatt et al., 2004; Munro et al., 2007; Smith et al., 1992). Such results are particularly surprising as psychopathy is often associated with reduced rather than hyper-

sensitivity to contextual cues that contraindicate their ongoing goal-directed behavior (see MacCoon et al., 2004 for review). Understanding the discrepancies between the findings of the current study and prior research is necessary to develop a more nuanced and comprehensive picture of the common and unique cognitive deficits related to psychopathy and APD.

Recent research with psychopathic offenders has clarified the circumstances that modulate sensitivity to incongruent contextual stimuli among psychopathic offenders. Using three variants of the Stroop task, Hiatt et al. (2004) found that offenders with primary psychopathy displayed less interference than controls when incongruent stimuli were spatially or temporally separated from the target stimuli, but they did not differ from controls when the target and incongruent stimuli were spatially integrated. Following MacLeod (1998), the authors proposed that when incongruent and target stimuli are spatially integrated, participants first process both stimuli and must subsequently inhibit the distracting information in order to produce the correct response. Conversely, when targets and incongruent stimuli have different physical characteristics (pictures vs. words, e.g., Newman, Schmitt, & Voss, 1997), appear in different locations (color words vs. surrounding box color, e.g., Hiatt et al., 2004) or at different points in time (e.g., Mitchell, Richell, Leonard, & Blair, 2006), or if the demands of the task focus attention on target stimuli and away from inhibitory cognitive (e.g., Zeier, Maxwell, & Newman, 2009) or emotional stimuli (e.g., Baskin-Sommers, Curtin, & Newman, 2010), it is easier to set an early selection filter that facilitates focusing on the target and ignoring incongruent stimuli. Psychopathic participants appear to be particularly adept at employing such early attention filters; thus, in each of these circumstances, they are relatively impervious to salient distracters. In other words, psychopathic individuals display minimal interference when early selection allows them to filter out distracters, but normal or, as in the current study, greater interference when proper performance requires late selection. Conversely, antisociality appears to be unrelated to differences in early selection but is associated with less efficient late attention systems.

Assuming that psychopathy is associated with an early selection bias, the performance of psychopathic individuals in this study suggests that they were unable to employ early selective attention to gate out distracters. In light of the fact that targets were consistently presented in the central location, it is somewhat surprising that they did not focus on these stimuli to the exclusion of the flanker stimuli and display less interference. However, this fact may reflect the close spatial proximity of the targets and flankers (i.e., both the target and distracters appeared within the scope of visual attention) or other physical aspects of the stimulus display that made it more difficult to separate targets and incongruent distracters (e.g., both were characters presented in the same font). Alternatively, it may not have been possible for them to establish a goal-relevant focus of attention that excluded distracters because the target set overlapped with the incongruent distracter set (i.e., both were numbers and letters). Further research is needed to evaluate these alternatives.

The results also suggest that when early selection is not possible, psychopathy may in fact be associated with poorer cognitive control (i.e., late selection). Psychopathic offenders committed more errors than controls on incongruent trials—a finding that appears to reflect antisociality more generally. In light of the fact that early selection may eliminate the need for late selection (Lavie, 2005), an interesting possibility in this regard is that the poor cognitive control of psychopathic offenders will tend to be expressed only when early selection is not possible. Conversely, when early selection is possible, it will tend to obfuscate their late selection deficit. It should be noted that the evidence on cognitive control in psychopathy has been inconsistent, and further investigation is necessary to clarify the circumstances and underlying mechanisms that determine when psychopathy is associated with poor cognitive control. For example, the association between antisociality and cognitive control deficits, and thus the association between psychopathy and cognitive control deficits, may be stronger under conditions involving affectively significant stimuli (e.g., high stress or salient reward cues).

The findings are also informative with respect to the self-control problems of psychopathic and other antisocial individuals. Self-regulation has been defined as the "context appropriate balance of attention" to top-down (i.e.,

goal-relevant) and bottom-up (i.e., peripheral) stimuli (MacCoon et al., 2004). The former is highly dependent on the ability to ignore irrelevant distracters (late selection) in order to maintain a goal-relevant focus (e.g., maintaining abstinence or controlling aggressive reactions). However, as noted by MacCoon et al. (2004), self-regulation may also be undermined by abnormalities in early selection that interfere with a person's ability to accommodate unexpected information indicating that ongoing goal-directed behavior is nonoptimal or inappropriate. For example, whereas an early selection deficit may prevent someone from noticing that their goal-directed behavior is upsetting someone else (e.g., unwanted sexual advances), their late selection deficit may hamper their ability to inhibit such advances in order to avoid reincarceration. Consistent with claims set out by Morgan and Lilienfeld (2000), the present results suggest that antisociality is associated with a diminished capacity to maintain socially appropriate goal-directed behavior in the face of salient stimuli that activate competing responses. Further, the combined early and late selection deficits of psychopathic individuals reflect a "double-hit" of sorts, representing two different cognitive pathways that may impede effective self-regulation. This likely relates to the elevated severity and frequency of criminal activity found in psychopathic offenders.

Before concluding, we consider potential limitations of the current study. First, it is important to acknowledge that support for the predicted deficits in cognitive control was limited to analyses involving response accuracy as opposed to response times. Moreover, although statistically significant, the differences in response accuracy were small and further research is needed to determine the extent to which such differences may account for meaningful differences in self-regulation outside of the laboratory context. Further investigation is needed to determine whether reaction time and accuracy provide equally valid measures of cognitive control with the accuracy variable providing a more sensitive measure of performance or whether the two variables are tapping different psychological processes. In addition, while psychopathy has not been associated with significantly worse performance in previous investigations of cognitive control (e.g., Dvorak-Bertsch et al., 2007; Hiatt et al., 2004; Munro et al., 2007; Smith et al., 1992; Zeier et al., 2009), the current study had considerable power to identify group differences in cognitive control and found only a small, albeit significant, difference in response accuracy (vs. reaction time). Further research will be necessary to address these limitations, and to develop greater specificity in understanding the extent to which the association between antisociality and cognitive control is moderated by the combination of situational factors that allow for early selection and the presence of psychopathy.

In conclusion, the results of this study provide evidence of a significant association between antisociality, a general construct associated with both APD symptoms and psychopathy scores, and poor executive functioning as measured by responsivity to distracting, inhibitory information. Such findings are consistent with proposals (e.g., Morgan & Lilienfeld, 2000) that the self-regulation problems of antisocial individuals relate to problems with executive control, across different antisocial subtypes. By undermining effective self-regulation, this deficit may result in increased risk for a variety of antisocial behavior. Further research is needed to clarify the necessary and sufficient conditions for revealing early versus late selective attention anomalies in psychopathy and antisocial personality disorder. A more complete understanding of the common and unique deficits in these antisocial subtypes will allow for greater precision in the early identification of at-risk individuals, facilitate differential diagnosis, and inform the development of therapeutic interventions that are tailored to the specific strengths and weaknesses of these groups.

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