

Understanding Psychopathy

The Cognitive Side

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Psychopathy is a complex disorder of unknown etiology. Clinically, psychopathic individuals are striking for their shallow affect, lack of meaningful relationships, irresponsibility, impulsivity, and lack of insight into their disorder. Empirical studies of psychopathy have revealed emotion-processing deficits, such as poor fear conditioning (e.g., Flor, Birbaumer, Hermann, Ziegler, & Patrick, 2002; Hare & Quinn, 1971; Lykken, 1957) and reduced startle potentiation (e.g., Levenston, Patrick, Bradley, & Lang, 2000; Patrick, Bradley, & Lang, 1993; Patrick, Cuthbert, & Lang, 1994; Sutton, Vitale, & Newman, 2002), as well as deficits in broader cognitive processing, such as dual-task attention (e.g., Jutai, Hare, & Connolly, 1987; Kosson, 1996) and behavioral inhibition (e.g., Newman & Kosson, 1986; Newman, Patterson, Howland, & Nichols, 1990). Although both popular and empirical characterizations of psychopathy have tended to emphasize the emotion-processing deficits, the information-processing deficits associated with psychopathy provide critical insight into the disorder. A primary challenge for researchers attempting to understand the psychopathic syndrome is to elaborate the relationship between psychopaths' cognitive and emotional deficits such that the disorder

can be viewed within one theoretical framework. Toward this end, this chapter (1) provides a review of the major cognitive deficits that have been associated with psychopathy, and (2) suggests possible avenues for integrating these cognitive deficits with psychopaths' emotion-processing deficits, with the aim of promoting the development of a unified understanding of psychopathy.

STUDY SELECTION

The following review is restricted to studies that identify psychopathic participants by means of the Psychopathy Checklist (PCL; Hare, 1980) or Psychopathy Checklist—Revised (PCL-R; Hare, 1991). This restriction of studies is based on our strong belief that etiological understanding of psychopathy depends on the identification of a well-defined, relatively homogenous population. Because of the phenotypical overlap but presumed etiological differences among psychopathy and other externalizing-spectrum disorders (e.g., antisocial personality disorder), we feel that it is critical to use diagnostic methods that can reliably differentiate psychopathic and nonpsychopathic individuals. The PCL-R and its predecessor were derived from

Cleckley's (1982) classic description of the disorder, and the PCL-R is generally considered to be the premier instrument for assessing psychopathy among incarcerated populations. By restricting our review to studies employing this reliable and valid measure of psychopathy, we hope to provide a clear picture of the deficits that have been specifically associated with psychopathy. However, we acknowledge the contributions of research using alternative methods of psychopathy assessment, such as research involving community or adolescent populations, and we look forward to further validation of the psychopathy construct in these samples and the eventual integration of this work with the literature on traditional, PCL/PCL-R psychopathy.

For similar reasons, we also restrict the following literature review to studies involving male participants. Although empirical studies of PCL-R psychopathy among female populations are increasing, the generality of the construct across gender has yet to be firmly established (see Verona & Vitale, Chapter 21, this volume). Furthermore, there appear to be important performance differences between male and female PCL-R psychopaths (Vitale & Newman, 2001; Vitale, Smith, Brinkley, & Newman, 2002). Although we encourage further investigation of the similarities and differences among male and female psychopathic individuals, current knowledge is insufficient to allow straightforward integration of findings across male and female samples. Therefore, studies using female samples are excluded from this review.

LITERATURE REVIEW

Psychopathy has not traditionally been associated with cognitive dysfunction, at least with regard to intelligence, memory, and executive ability (e.g., Cleckley, 1982). Indeed, psychopaths are notorious for the contrast between their good explicit knowledge and their profound failures when put to the test of daily life. However, it is possible that the assumption of intact cognitive ability is based on an overly simplified model of cognitive and executive functions. It is widely recognized that cognitive control and adaptive self-regulation depend on much more

than adequate intelligence or the ability to perform well on traditional measures of executive ability. For example, what determines how top-down cognitive or executive resources will be directed, and which stimuli will become the focus of, and benefit from, the available cognitive resources? Clearly, the appropriate allocation of cognitive resources is as important to successful cognitive control and self-regulation as traditional executive functions such as goal maintenance. Thus, despite their good overall intelligence and cognitive ability, psychopaths may be impaired in more subtle aspects of cognition. Indeed, the existing literature on cognitive functioning among psychopaths reveals subtle but important abnormalities in several broad domains. These domains include attention, language processing, behavioral inhibition, and neuropsychological functioning.

ATTENTION

Interest in psychopaths' attentional functioning arose in part from their demonstrated insensitivity to incidental punishment cues (e.g., Lykken, 1957). In response to psychopaths' poor passive avoidance learning and aversive conditioning, Hare (1986) proposed that psychopaths, when not forced to attend to warning cues, "may be able to focus attention on things of immediate interest, effectively ignoring warning cues and other stimuli not of immediate interest to them" (p. 12). Consistent with this proposal, many studies indicate that psychopaths fail to accommodate secondary or unattended information.

Jutai and Hare (1983) found that psychopaths showed reduced physiological responsivity to irrelevant auditory stimuli when their attention was focused elsewhere, although they showed normal responsivity during passive listening. Autonomic and electrocortical activity was recorded while inmates with high and low ratings of psychopathy were presented with a series of binaural tone pips, either by themselves (passive attention) or while video games were being played (selective attention). During selective attention the subjects were told that the tone pips were irrelevant to the primary task. The N100 component of the auditory evoked po-

tential was used as an index of attention paid to the tone pips, while performance on the video games was considered to be a reflection of attentiveness to the primary task. Psychopaths displayed normal N100 responses to the tone pips presented alone. However, psychopaths gave small N100 responses to the tone pips during each trial, including the first one, when they were engaged in playing the video game. In contrast, nonpsychopaths gave large N100 responses to tone pips during the first trial and small responses during later trials. Jutai and Hare interpreted this result in terms of limited-capacity models of attention and suggested that psychopaths allocate a relatively large proportion of their attentional resources to events of immediate interest, effectively ignoring other stimuli.

Similarly, Newman and colleagues (Hiatt, Schmitt, & Newman, 2004; Newman, Schmitt, & Voss, 1997; Smith, Arnett, & Newman, 1992) have demonstrated that psychopaths show reduced interference from irrelevant distractors on certain Stroop-like paradigms. Newman, Schmitt, and Voss (1997) presented psychopaths and nonpsychopaths with a picture-word interference task. At the start of each trial, the relevant (to-be-attended) dimension was indicated by the letter *P* or *W*. A compound picture-word stimulus (line drawing with superimposed word) was then presented, followed by a test stimulus (a picture on *P* trials, a word on *W* trials). Participants were to judge whether the relevant dimension of the compound stimulus was semantically related to the test stimulus. Nonpsychopaths showed significant reaction time interference for trials in which the irrelevant, but not the relevant, dimension of the compound stimulus was related to the test stimulus (i.e., correct response "unrelated"), particularly when the irrelevant stimulus was a word. Psychopaths failed to show this interference effect, indicating decreased sensitivity to unattended contextual information.

However, Smith and colleagues (1992) found normal Stroop interference among psychopaths on the standard color-word Stroop. To further examine psychopaths' selective attention, Hiatt and colleagues (2004) presented psychopathic and nonpsychopathic inmates with three different Stroop-like tasks: the standard color-word Stroop, a picture-word Stroop, and the "box" Stroop,

in which color-words appeared inside a colored rectangular frame, thereby spatially separating the color and color-word components. Hiatt and colleagues found that psychopaths showed normal Stroop interference on the standard, spatially coincident color-word Stroop but reduced interference on the spatially separated picture-word and box Stroop tasks.

The Stroop interference displayed by healthy participants indicates that incongruent but task-irrelevant information interferes with primary task performance, despite participants' attempts to ignore this information. Psychopaths show normal Stroop interference when the target and distractor overlap spatially (e.g., the word *BLUE* written in green ink) but show dramatically reduced interference when the target and distractor are spatially separated (e.g., the word *BLUE* in white ink, surrounded by a green rectangle). In the spatially separated condition, the primary task information (e.g., the color of the rectangle) can be attended separately from the secondary task information (e.g., the word *BLUE*). Nevertheless, the interference demonstrated by healthy controls indicates that focused attention is modulated by the secondary information that occurs outside the deliberate attentional focus. Psychopaths, however, fail to show this attentional modulation, consistent with poor accommodation of secondary or contextual information that occurs outside their primary attentional focus.

Similarly, Christianson and colleagues (1996) found that psychopaths failed to show the typical emotion-modulated narrowing of attention when they were unexpectedly presented with a slide depicting an aversive scene. Controls showed poorer recall for peripheral details on the aversive relative to neutral slides, whereas psychopaths showed good recall of both central and peripheral details, regardless of emotional content. Thus, despite reporting a typical emotional reaction to the scene and showing good recall for the details of the slide, psychopaths' attentional processing did not appear to be affected by the emotional nature of the slide. This finding indicates that psychopaths' performance on the primary task of attending to slides was unaffected by the unexpected emotional information and is consistent with deficient modulation of at-

rention by secondary or contextual information.

Also consistent with poor processing of information that occurs outside the attentional focus, psychopaths show abnormal event-related potential (ERP) responses to auditory "oddball" targets when they are engaged in a distractor task. Jutai and colleagues (1987) recorded ERPs to phonemic stimuli while psychopaths and nonpsychopaths performed a speech discrimination "oddball" paradigm in which participants were required to respond whenever the target (oddball) phoneme occurred. ERPs were recorded while participants performed the oddball task alone (single-task condition) and simultaneously performed a distractor video-game task (dual-task condition). There were no group differences in performance or on measures of central arousal (N100) during the single- or dual-task conditions. However, psychopaths' P300 responses to the target under dual-task conditions were notable for an overlapping positive slow wave, primarily at vertex and left-hemisphere sites. Jutai and colleagues interpreted this positive slow wave as evidence of unusual speech processing in psychopaths under conditions of distraction. They proposed that psychopaths' large slow wave may reflect increased processing effort and suggested that psychopaths may have had some difficulty keeping track of the sequential probabilities of the speech stimuli (e.g., that two targets never occurred in a row) when engaged in the video game.

In addition to poor processing of secondary or incidental information, there is some evidence that psychopaths allocate excessive attention to their primary task. Forth and Hare (1989) recorded electrocortical responses among psychopathic and nonpsychopathic inmates during the interval between a warning tone and an imperative tone. Participants were instructed to press a response button as quickly as possible on hearing the imperative tone and were also informed that the pitch of the warning tone on each trial indicated whether they would win money for a fast response, lose money for a slow response, or neither win nor lose money on that trial. Forth and Hare found no group differences in N100 or P300 responses but did find that the early (600–1,500 milliseconds) contingent negative variation (CNV)

response was larger among psychopaths than controls. Forth and Hare interpreted the early CNV as a reflection of attention to the warning stimulus and task demands and suggested that psychopaths may be more proficient than nonpsychopaths at focusing attention on events that interest them.

There is also evidence that incidental processing of contextual information may be relatively uncoupled from primary attention among psychopaths relative to controls. Bernstein, Newman, and Wallace (2000) asked participants to memorize a series of eight words that were presented one at a time, with two words appearing in each corner of the video display. This explicit word recall task produced the expected left-hemisphere advantage among both psychopaths and controls, with better recall for words that were presented on the right versus the left side of the monitor. Following the word recall task, participants were unexpectedly asked to recall the spatial position in which each word had appeared. This incidental recall of locations followed the pattern of word recall among controls, with better accuracy for the spatial locations of words that had appeared on the right side of the monitor. This finding suggests that controls' processing of the incidental spatial information was to some extent coupled with their primary focus of attention. Among psychopaths, however, recall accuracy was equally distributed across both visual fields. According to Bernstein and colleagues, secondary attention appears to be more closely tied to primary attention among controls than among psychopathic individuals. One consequence of this group difference is that controls may be more likely to process multiple dimensions of a stimulus (or event) that is the focus of primary attention.

The preceding findings provide consistent evidence that psychopathy is associated with rigid task-focused attention that is poorly modulated by secondary or incidental information. However, the picture becomes somewhat more complex when psychopaths are presented with demanding dual-task paradigms. Kosson and Newman (1986) presented participants with a visual search task, in which participants counted the number of targets that appeared across each set of 8 test frames, and a go/no-go task, in which they were to respond as quickly as possible to

low-pitched but not high-pitched tones. In one condition, participants were told to focus on the visual search task, while in the other condition they were told to divide attention equally between the two tasks. Psychopaths made more visual-search errors than nonpsychopaths under the divided attention condition, and they tended to make fewer visual-search errors than nonpsychopaths in the focused condition. Across conditions, psychopaths responded slower than nonpsychopaths to the target tones.

Psychopaths' increase in visual-search errors under divided attention conditions does not immediately appear to be consistent with poor accommodation of secondary information when attention is allocated elsewhere, which suggests that psychopaths may have a more general difficulty in distributing attention across multiple complex response contingencies. However, it is possible that nonpsychopaths make use of relatively automatic attentional processing (as opposed to top-down effortful attention) to manage multiple response contingencies, and that psychopaths' difficulty accommodating secondary or peripheral information requires them to compensate by using a more effortful, top-down approach to the task. A more effortful, top-down approach to this complex dual-task paradigm may account for psychopaths' slower responses to the target tones and tendency to commit visual-search errors under divided attention conditions. This proposal is consistent with Kosson and Newman's (1986) suggestion that psychopaths may incur relatively large-capacity costs in attempting to shift their attentional resources between processing tasks.

In a second dual-task study, Kosson (1996) presented participants with two simultaneous classification tasks. Participants were asked to classify symbol strings as all numbers, all letters, or a mixture (50%), but only if the string appeared in a horizontal rather than vertical frame. They were also asked to classify a four-tone sequence as increasing in pitch, maintaining constant pitch, or a mixture, but only if the tones were relatively low pitched. The relative priority of each task was manipulated by target frequency rather than by explicit instructions; visual targets were more likely than auditory targets. In the dual-task condition, some tri-

als had two targets (i.e., both a visual and an auditory target) and some trials had one target. Kosson found no group differences in responses to either primary- or secondary-task targets under dual-task conditions, nor were there any group differences when either the visual or the auditory task was presented alone. However, psychopaths overresponded to secondary-task distractors, especially when they followed a primary-task target. Kosson interpreted psychopaths' responses to distractors as consistent with a failure to "process peripheral stimulus features in attention-demanding situations" (p. 398). Psychopaths also displayed a trend toward a performance deficit in primary task accuracy when the primary-task target followed a secondary-task target and they were responding with their right hand to the primary task, which Kosson interpreted as consistent with a deficit in "shifting attention under conditions involving left hemisphere processing resources" (p. 398).

These findings by Kosson and colleagues (Kosson, 1996; Kosson & Newman, 1986) are consistent with poor use of secondary information but also suggest a possible hemispheric asymmetry such that attentional processing is disrupted by phasic left-hemisphere activation. Kosson (1998) examined psychopaths' performance on a divided visual field task with two lateralized stimuli per trial and provided further evidence for the importance of left-hemisphere activation. Participants were to classify symbol strings as all numbers, all letters, or a mixture, but only if the string appeared in green rather than yellow type. Attention to the two stimuli was manipulated by target frequency; in one condition (relatively focused attention) targets were more frequent in one visual field, while in the other condition (equally divided attention) targets were equally likely to occur in either visual field. When the majority of the targets were presented in the right visual field (RVF), psychopaths misclassified more left-visual-field (LVF) targets and marginally more RVF targets than nonpsychopaths. Psychopaths also overresponded to distractors on both tasks under focusing conditions. There were no group differences in performance under single-task conditions (i.e., when only one stimulus was presented per trial). Kosson proposed that "reduced breadth of attention under focus-

ing conditions and cognitive deficits given left hemisphere activation appear viable explanations of psychopaths' performance deficits" (p. 373).

Howland, Kosson, Patterson, and Newman (1993) also found evidence that psychopaths' attentional abnormalities may be exacerbated by left-hemisphere activation. Howland et al. examined the attentional performance of psychopaths and nonpsychopaths on an exogenously cued Posner task. They found that psychopaths made more errors than nonpsychopaths following invalid RVF cues. Given that RVF cues are initially processed by the left hemisphere, and vice versa, this finding indicates that psychopaths had difficulty shifting attention from left-hemisphere (RVF) cues to right-hemisphere (LVF) targets and provides further evidence that left-hemisphere activation may contribute to psychopaths' attentional abnormalities. Howland and colleagues also found that psychopaths made more errors than controls on neutral trials for which the imperative stimulus appeared in the RVF.

Kiehl, Hare, Liddle, and McDonald (1999) found that psychopaths' P300 differentiation between targets and nontargets was reduced relative to nonpsychopaths on a visual oddball task, although psychopaths' behavioral performance was comparable to that of controls. Participants were instructed to respond as quickly as possible to the infrequent target stimulus by pressing a response key with their right hand. Psychopaths showed normal ERPs to nontarget stimuli, but, unlike controls, they failed to show reliable P300 amplitude differences between the target and nontarget conditions. P300 responses were generally greater in the right than the left hemisphere, but psychopaths' P300 responses were less lateralized to the right hemisphere than those of controls. In contrast, psychopaths showed larger left-hemisphere N550 responses than controls to target stimuli. Thus, psychopaths showed reduced P300 differentiation between targets and nontargets, showed less P300 lateralization to the right hemisphere, and showed a greater left-hemisphere N550 response to target stimuli. Consistent with psychopaths' proposed difficulty modulating task-focused attention, Kiehl, Hare, Liddle, and colleagues (1999) interpreted psychopaths'

poor P300 differentiation as consistent with deficient sustained attention or unusual allocation of attentional resources to task demands and suggested that psychopaths' attention, once focused, may be difficult to remobilize. This study provides physiological evidence that is consistent with both poor distribution of attention and unusual lateralization of processing across the cerebral hemispheres.

Thus, both behavioral and physiological investigations of psychopaths' attentional functioning are largely consistent with rigid task-focused attention that is poorly modulated by secondary or contextual information. In addition, these studies suggest that psychopaths' attentional insensitivity to secondary or contextual information may be exacerbated by left-hemisphere activation. The possible contribution of left-hemisphere activation suggests a potential refinement of psychopaths' difficulty accommodating unattended contextual information. We return to this possibility in the discussion section.

LANGUAGE

Psychopaths' notorious abilities to manipulate, and the apparent disconnect between their statements and their intentions, has led to substantial interest in the ways in which psychopaths use and understand language. As paraphrased by Hare (1986), "Cleckley long held that the speech of psychopaths appears to be a mechanically correct artifact that masks a semantic disorder in which the formal, semantic, and affective components of language are dissociated from one another" (p. 21). Hare suggested that this disorder may involve "unusual or abnormal interactions among the cortical, subcortical, and limbic mechanisms responsible for the integration of verbal, emotional, and social behavior" (p. 22). Empirical studies of psychopaths' language processing have revealed abnormalities that fall into two major categories: (1) the use of associative or contextual aspects of language such as connotation, affect, abstract meanings, and metaphor; and (2) unusual functional cerebral asymmetries for processing verbal stimuli.

Hare, Williamson, and Harpur (1988) reported that psychopaths, when asked to choose the two words in a triad that were

most similar in meaning, tended to group words on the basis of denotation and literal meaning (e.g., antonyms). In contrast, nonpsychopathic controls tended to group words on the basis of their connotations (e.g., metaphorical relationships and emotional polarity). Based on these data, Hare and colleagues suggested that psychopaths may be less sensitive than controls to the connotative meanings of language. Similarly, Herve, Hayes, and Hare (2003) reported that incarcerated PCL-R psychopaths made significantly more sorting errors than nonpsychopaths on an emotional metaphor Q-sort task, despite having good literal understanding of the metaphors. They concluded that these results support the hypothesis that "incarcerated psychopaths do not understand or make effective use of the emotional content of language" (p. 1497).

Williamson, Harpur, and Hare (1991) demonstrated that psychopaths fail to show the normal reaction time facilitation for emotional words on a lexical-decision task, indicating poor accommodation of unexpected affective information. Psychopaths also showed poor ERP differentiation between neutral and emotional words. In addition, the positive slow wave component of the ERP was relatively small and brief among psychopaths relative to controls, and was preceded for both neutral and emotional words by a large centrofrontal negative wave (N500). Williamson et al. suggested that psychopaths' slow lexical-decision reaction times, short-lived late positive ERP, and abnormal N500 reflect difficulty integrating word meanings within broader linguistic or conceptual structures.

Lorenz and Newman (2002) replicated Williamson and colleagues' (1991) finding of reduced emotion facilitation among psychopaths on a lexical-decision task. However, Lorenz and Newman found that psychopaths' lack of emotion facilitation was specific to right-handed responses. When performing the lexical-decision task with their left hand, psychopaths' emotion facilitation was equivalent to that of controls. As right-handed responses are controlled by the left hemisphere, this result is reminiscent of Kosson's (1996, 1998) findings that the failure of psychopaths to accommodate contextual or secondary information is exacerbated by left-hemisphere activation.

Kiehl, Hare, McDonald, and Brink (1999) examined psychopaths' ERP responses to semantic and affective verbal information, using lexical-decision and word discrimination tasks with either concrete (e.g., "chair") and abstract (e.g., "justice") or positive and negative words. Kiehl and colleagues found that psychopaths made more errors identifying abstract than concrete words. On all tasks, psychopaths failed to show the normal ERP differentiation between types of word stimuli. In addition, the ERPs of psychopaths included a large centrofrontal negative-going wave (N350) that was absent or very small among nonpsychopaths.

Psychopaths also show relative deficits in the global coherence of their language. Brinkley, Newman, Harpur, and Johnson (1999) found that psychopaths' narratives included fewer cohesive ties per clause than those of nonpsychopaths. Brinkley, Bernstein, and Newman (1999) asked participants to generate stories including specific plot units (i.e., story elements or themes), and found that psychopaths closed fewer plot units than nonpsychopaths. Gillstrom and Hare (1988) examined psychopaths' use of hand gestures during speech. They recorded hand gestures that served to illustrate what was being said (iconic gestures) and small, repetitive, apparently unintentional gestures (beats) during videotaped interview segments in which participants discussed their family life and criminal offenses. Participants with high PCL scores used significantly more beats than those with low or moderate PCL scores, and the latter two groups did not differ from one another.

Although psychopaths' language abilities are grossly intact, the preceding studies indicate that psychopaths have difficulty using the more subtle or contextual aspects of language. In many instances, this difficulty involves the use of emotional connotation in language, although psychopaths also have difficulty with abstract concepts and global cohesion. While the neural bases of these connotative and contextual components of language are not fully understood, it is reasonable to presume that they depend on broad and relatively automatic activation of semantic networks. In this sense, they may be considered "secondary" aspects of language that automatically influence process-

ing in normal controls. Consistent with their difficulty using secondary information in other domains, psychopaths may have difficulty making use of these broad linguistic associations without deliberately attending to them. Importantly, psychopaths are able to accurately evaluate and use emotion and connotation in language when explicitly required to do so (e.g., Levenston et al., 2000; Patrick et al., 1993; Williamson et al., 1991).

In addition to their poor use of secondary or contextual aspects of language, psychopaths also show abnormal cerebral asymmetries on certain language processing tasks. Although psychopaths show a normal left-hemisphere advantage for the identification (Hare, 1979), detection (Hiatt, Lorenz, & Newman, 2002), and recall (Bernstein et al., 2000) of common words, other studies have revealed abnormal language lateralization among psychopathic individuals. Hare and McPherson (1984) found a reduced right-ear advantage among psychopaths on a dichotic listening task in which participants were asked, at the end of each set of three word pairs, to report all the words they could recall hearing. Hare and Jutai (1988) examined psychopaths' cerebral asymmetries for the categorization of words into specific (four-footed animal, vehicle, bird, or weapon) or abstract (living or nonliving) categories. Words were briefly presented in either the LVF or RVF, and participants indicated whether or not the word was a member of the specified category by pressing the appropriate response button. On the simple categorization task, both psychopaths and nonpsychopaths showed the expected RVF advantage. On the abstract categorization task, nonpsychopaths continued to show a RVF advantage while psychopaths showed a large LVF advantage. Thus, psychopaths displayed a normal RVF/left-hemisphere advantage for the classification of words into concrete, but not abstract, categories. Together, these studies suggest that the processing of complex language-based tasks is less lateralized to the left hemisphere among psychopaths than controls, although psychopaths show normal left-hemisphere lateralization for simple linguistic tasks.

Although the number of studies is limited, the available evidence suggests that psychopaths' use of language tends to be unelaborated and lacking in associative depth.

In addition to this poor use of secondary aspects of language, psychopaths show a reduced left-hemisphere advantage for the classification of abstract words and for the delayed recall of dichotically presented word pairs but a normal left-hemisphere advantage for simple word identification, recognition, and recall, as well as for the classification of concrete words. These laterality findings suggest that psychopaths have reduced lateralization of processing for language tasks that require the use of broad associations (e.g., categorizing abstract words) or entail heavy processing demands (e.g., recall of dichotically presented word pairs). Note that unusual asymmetry effects (i.e., poor distribution of attention under left-hemisphere activating conditions; unusual ERP lateralization) were also observed in physiological and behavioral studies of psychopaths' attentional processing, suggesting that abnormal functional cerebral asymmetries may be a consistent feature of psychopathy.

BEHAVIORAL INHIBITION

Poor behavioral inhibition is one of the hallmark features of psychopathy and has been the focus of numerous investigations. Many of these investigations have used passive avoidance paradigms, which require participants to inhibit responses in order to avoid punishment. The earliest study of passive avoidance in psychopaths was conducted by Lykken (1957). Lykken used a "mental maze" in which participants were required to navigate choice points in a maze by pressing one of four response levers. There was one correct lever at each decision point. The passive avoidance component of the task involved a latent shock contingency: At each decision point, one of the three incorrect response levers was paired with an electric shock. Passive avoidance was measured by the increased avoidance of shocked responses across trials. Lykken found that psychopaths committed more passive avoidance errors than nonpsychopathic controls.

Attempts to replicate Lykken's (1957) finding have produced mixed results and have revealed that psychopaths' passive avoidance deficits are context dependent. Schmauk (1970) used a modified version of

Lykken's task, and examined passive avoidance under conditions involving verbal punishment ("wrong"), tangible punishment (loss of 25 cents), or physical punishment (electric shocks). In the conditions involving verbal and physical punishment, low-anxious psychopaths displayed smaller skin conductance responses, poorer passive avoidance learning, and less awareness of the punishment contingencies than did nonincarcerated controls. However, the groups did not differ on any of these measures when the punishment contingency involved loss of money.

Later studies by other researchers have found passive avoidance deficits even with loss of money (Newman & Kosson, 1986; Newman, Patterson, & Kosson, 1987; Siegel, 1978). Newman and colleagues (1990) argued that, unlike Schmauk (1970), each of the studies demonstrating poor passive avoidance under conditions of monetary loss also involved a competing reward contingency. They argued that a competing reward contingency is an important component of psychopaths' poor passive avoidance.

Several studies have explicitly investigated the effect of reward contingencies on psychopaths' passive avoidance performance. Newman and Kosson (1986) presented participants with two versions of a passive avoidance task. In one version (reward + punishment), participants received both reward and punishment feedback. If their response was incorrect, they heard a tone and lost 10 cents. If their response was correct, they heard a different tone and earned 10 cents. In the other version (punishment only), participants received only punishment feedback; they lost money if they responded to a punished stimulus or failed to respond to a rewarded stimulus. No feedback was given after correct responses. Psychopaths made more passive avoidance (commission) errors than controls in the version involving competing reward and punishment contingencies but performed comparably to controls in the punishment-only condition. Newman and Kosson concluded that psychopaths show poor passive avoidance only in the presence of competing reward contingencies.

Similarly, Newman and colleagues (1990) found poor passive avoidance among psy-

chopaths relative to controls when participants were engaged in a task that emphasized obtaining rewards, but psychopaths performed comparably to controls when punishment and reward contingencies were salient from the start of the task and given equal emphasis. Furthermore, using subject-terminated response feedback, they found that in the task emphasizing rewards, psychopaths paused less than controls following negative feedback, and the extent to which participants paused following negative feedback was correlated with passive avoidance learning. Newman and colleagues concluded that it is not the presence of reward per se but, rather, the need to interrupt a dominant reward-seeking set in order to process and learn from punishment feedback that disrupts psychopaths' passive avoidance learning.

Arnett, Smith, and Newman (1997) provided further evidence that psychopaths show normal avoidance of explicit punishment contingencies. They employed a simple stop-signal task, in which participants were required to respond to targets as quickly as possible but refrain from responding if an inhibitory cue was also present. Psychopaths showed normal behavioral inhibition on this task. Similarly, Newman, Wallace, Schmitt, and Arnett (1997) found normal response inhibition among psychopaths when participants were instructed to search a letter string and respond to targets unless the letter "Q" also appeared in the letter string. These studies demonstrate that psychopaths show good behavioral inhibition when the inhibitory cues or punishment contingencies are made explicit. Kiehl, Smith, Hare, and Liddle (2000) also found good behavioral inhibition among psychopaths on an explicit go/no-go task. However, they found that psychopaths' ERP responses to the go and no-go stimuli were abnormal, with less differentiation between the go and no-go stimuli at the N275 and reversed differentiation (no-go greater than go) at the P375 component. This finding suggests that psychopaths' processing of straightforward inhibition tasks may differ from that of nonpsychopaths, despite their good performance.

As mentioned previously, Newman and colleagues (1990) found that psychopaths paused less than controls following negative feedback, and they proposed that the need to

interrupt a dominant reward-seeking set is a critical feature of psychopaths' passive avoidance deficits. Providing support for this proposal, Newman and colleagues (1987) demonstrated that forced pauses can remedy psychopaths' poor behavioral inhibition in the presence of prepotent reward contingencies. They presented psychopaths and controls with three different versions of a card-playing task. In each task, the probability of reward declined steadily across trials while the probability of punishment increased steadily. To perform successfully (i.e., maximize winnings), participants needed to stop playing cards approximately halfway through the 100-trial task. The three task versions differed in the feedback given to participants. In the first version, participants received feedback after each response but no cumulative feedback. In the second version, cumulative results were displayed on the screen after each response. In the third version, cumulative results were displayed and participants were forced to pause for 5 seconds before the start of the next trial. Newman and colleagues found normal response inhibition among psychopaths only in the third condition, when they were forced to pause for 5 seconds following feedback.

A study by Mitchell, Colledge, Leonard, and Blair (2002) suggests that psychopathic individuals also perform more poorly than controls on Bechara, Damasio, Damasio, and Lee's (1999) four-pack gambling task (Mitchell, Colledge, Leonard, & Blair, 2002). This task allows participants to play cards from any of four decks. Two decks are "risky," with occasional large rewards but an overall net loss, and two decks are "safe," with smaller rewards and an overall net gain. Mitchell and colleagues found that controls learned to avoid the "risky" decks over time, whereas psychopaths did not. Thus, psychopaths failed to modify their reward-seeking behavior in accord with punishment feedback.

However, an earlier study by Schmitt, Brinkley, and Newman (1999) found no evidence of group differences on the four-pack gambling task, although their procedure differed from that of Mitchell and colleagues (2002) in that they did not explicitly instruct participants that some decks were better than others and they

used a small amount of real money rather than play money to represent losses and gains. A recent study by Lösel and Schmucker (2004) used the same methods as Mitchell and colleagues and again found no evidence of group differences. Lösel and Schmucker suggested that the performance of psychopathic individuals is moderated by attentional skills, with "less attentive" psychopaths making poorer decisions than those with strong attention skills. The factors driving psychopaths' performance on the four-pack gambling task and the reliability of psychopaths' disinhibition on this task remain to be resolved.

Mitchell and colleagues (2002) reported a second experiment that provides additional evidence of disinhibition among psychopaths. This second study employed an instrumental learning task that required participants to use feedback ("correct" or "incorrect") to learn which of two stimuli they should select on each trial. The stimuli and the correct choices were periodically altered, requiring participants to adjust their response strategies. Psychopaths did not differ from controls in their ability to learn which stimulus should be responded to when new pairs of stimuli were presented. However, psychopaths made more errors than controls when the stimulus pairs remained the same but the reward contingencies were reversed. These findings suggest that psychopaths are adept at learning reward contingencies for novel stimuli but may have difficulty withholding responses to previously rewarded stimuli.

The foregoing studies reveal consistent behavioral disinhibition among psychopaths, but these deficits appear to be quite sensitive to task conditions. In general, psychopaths' behavioral disinhibition is most evident when there is a predominant reward contingency for responding and when participants are not required to pause for feedback between responses. Thus, psychopaths appear to have difficulty inhibiting previously punished responses when they are actively engaged in reward-seeking approach behavior. As argued by Newman, Schmitt, and Voss (1997), psychopaths appear to have no difficulty avoiding punishment when (1) avoidance learning is their only goal (i.e., there is no approach contingency; Newman & Kosson, 1986); (2) the

avoidance contingency is made salient from the outset of the task (Newman et al., 1990); or (3) positive and negative feedback are provided during an extended intertrial interval, thereby reducing the need for efficient processing of negative/avoidance feedback (Arnett, Howland, & Smith, 1993; Newman et al., 1987).

It should be noted that these findings are most robust in comparisons involving low-anxious psychopaths and controls; high-anxious controls are frequently as disinhibited or more disinhibited than high-anxious psychopaths. The reason for this specificity has yet to be fully explained. One possibility is suggested by Gray's (1982; see also Fowles, 1980) model of behavioral inhibition system (BIS) functioning, which corresponds to the anxiety dimension assessed by the Welsh Anxiety Scale (Welsh, 1956). According to this model, higher levels of anxiety are associated with increasing arousal and inhibition in response to cues for punishment. Trait anxiety may therefore be a particularly important moderator of psychopaths' performance on tests of behavioral inhibition, which directly assess responses to punishment cues. Regardless, psychopaths' behavioral disinhibition has also been observed irrespective of anxiety (e.g., Mitchell et al., 2002; Newman & Kosson, 1986; Newman et al., 1987).

As with psychopaths' attentional and language-processing abnormalities, psychopaths' behavioral inhibition deficits reveal evidence of difficulty using information that occurs outside the primary focus of attention. Thus, poor accommodation of secondary or incidental information appears to be a consistent feature of psychopaths' cognitive functioning. Although psychopaths' hemispheric processing asymmetries have not been investigated within the domain of behavioral inhibition, it is worth noting that reward-seeking behaviors may differentially activate the left hemisphere (e.g., Davidson 1995; Miller & Tomarken, 2001; Sobotka, Davidson, & Senulis, 1992). The exacerbation of psychopaths' disinhibition in the presence of a reward-seeking response set may therefore be consistent with Kosson's (1996, 1998) findings of attentional dysfunction under left-hemisphere activating conditions.

NEUROPSYCHOLOGICAL FUNCTIONING

A number of researchers have examined the performance of psychopathic individuals on standardized neuropsychological tests. Consistent with Cleckley's clinical insight, these tests generally fail to reveal clinically significant deficits among psychopathic populations. However, psychopaths do display circumscribed abnormalities relative to non-psychopathic controls on a minority of neuropsychological tests.

Hare (1984), following Gorenstein's (1982) report of poor frontal functioning among inpatients with psychopathic features, administered the Wisconsin Card Sorting Test (WCST), Necker cube, and a sequential matching memory task to incarcerated PCL psychopaths and controls. Hare found no evidence of group differences on any of these measures, and concluded that "the performance of both the inmates in general and the psychopaths in particular was very similar to that of normal or non-criminal individuals and not at all like that of frontal lobe patients" (p. 138).

Hart, Forth, and Hare (1990) administered neuropsychological batteries to two large samples of incarcerated PCL-R psychopaths and nonpsychopaths. One battery consisted of the Trail-Making Test, Visual Retention Test, Auditory-Verbal Learning Test, and Visual Organization Test. A second battery included the Trail-Making Test, Controlled Word Association Test, Vocabulary and Block Design subtests of the Wechsler Adult Intelligence Scale—Revised (WAIS-R), and the Wide Range Achievement Test, Second Edition, Reading. Hart and colleagues found no group differences on any of the tests, and concluded that the results "offer no support for traditional brain-damage interpretations of psychopathy" (p. 377).

However, Smith, Arnett, and Newman (1992) found evidence for circumscribed neuropsychological deficits among low-anxious psychopaths. They administered tests of executive (Controlled Word Association Test, Trail-Making Test, Category Test, Stroop), memory (Digit Span, Paired Associate Learning), motor (Finger Tapping), and visuospatial (Block Design) functions to a large sample of incarcerated PCL psycho-

paths and controls. They found no group differences in performance among high-anxious psychopaths and controls, but low-anxious psychopaths performed more poorly than controls on Block Design and Trails-B. These findings stand in contrast to those of Hart and colleagues (1990) and suggest that anxiety may moderate the expression of neuropsychological deficits among psychopaths. Interestingly, and as noted by Smith and colleagues, the specificity of low-anxious psychopaths' deficits to the Block Design and Trails-B subtests suggests that they may be "less adept at cognitively demanding activities mediated primarily by the right hemisphere—at least while actively engaged in motor responding" (p. 9).

LaPierre, Braun, and Hodgins (1995) administered tests associated with orbitofrontal/ventromedial functions (a go/no-go discrimination task, the Porteus Maze task, and the Modular Smell Identification Test), frontodorsolateral function (WCST perseverative errors), and right posterior cortex (mental rotation) to PCL-R psychopaths and incarcerated nonpsychopaths. They found that psychopaths made more olfactory identification errors, more commission errors on the go/no-go task, and more qualitative errors on the Porteus Maze. Psychopaths and controls did not differ on any other measures. The authors concluded that these findings are "concordant with the hypothesis of a specific ventral frontal dysfunction in psychopathy" (p. 146).

Pham, Vanderstukken, Philippot, and Vanderlinden (2003) administered a letter cancellation task, the Porteus Maze task, the Tower of London Test (TOL), the Stroop, the Trail-Making Test, and a modified WCST to PCL-R psychopaths and controls. Psychopaths committed more qualitative errors on the Porteus Maze (e.g., crossed walls), made more errors on the letter cancellation test and had more variability in the number of items read per line, and made excessive "moves" and took more time on misleading TOL problems. The authors interpreted these findings as consistent with a selective attention deficit and poor control of attention when exposed to distracters.

The foregoing studies reveal that psychopaths perform normally on the majority of neuropsychological tasks. However, two

studies have reported greater qualitative errors (e.g., crossing walls) among psychopaths relative to controls on the Porteus Maze task, and poor performance relative to controls has also been reported for the Modular Smell Identification Test, Trail-Making Test—Part B, and the Block Design subtest of the WAIS-R. The Modular Smell Identification Test has been linked to orbitofrontal cortex (OFC) and might suggest OFC impairment among psychopaths. The remaining tests on which psychopaths have shown deficits relative to controls all involve visuospatial processing and suggest that psychopaths may have difficulty performing complex visuospatial processing, at least while engaged in active motor responding.

These neuropsychological findings are not obviously congruent with the attentional deficits or abnormal cerebral asymmetries observed in studies of psychopaths' functioning in the domains of attention, language, and behavioral inhibition. However, further consideration reveals possible connections. As argued by Newman and Wallace (1993), psychopaths' specific difficulty with tasks that involve perceptual-motor integration may relate to their attentional difficulties, as these tasks require frequent shifts of attention between planning motor behavior and analyzing stimulus materials. Further, visuospatial tasks are likely to rely heavily on right-hemisphere processing and again suggest a possible influence of cerebral asymmetries upon psychopaths' performance.

DISCUSSION

The extensive literature on cognitive and language processing among psychopathic individuals reveals a broad array of deficits. Although emotion deficits are often emphasized in etiological models of the disorder, it is clear that psychopathy is also associated with reliable and specific cognitive abnormalities.

One intriguing aspect of psychopaths' cognitive deficits is their circumscribed, context-specific nature. Psychopaths' attentional functioning is characterized by good performance on explicit tasks presented in isolation but poor distribution of attention on

complex dual-task paradigms and poor modulation of attention by unexpected or secondary information. Psychopaths' language processing is characterized by poor spontaneous use of cohesion, elaborative associations, and connotation. Psychopaths' performance on tests of behavioral inhibition reveals poor inhibition of punishable responses only in the presence of a dominant reward-seeking response set and in the absence of instructions to pause and process performance feedback. Finally, psychopaths show normal performance on a broad array of neuropsychological tasks but have difficulty with olfactory identification and with complex visuospatial tasks that require concurrent motor responses. Together, these deficits indicate that psychopaths generally perform well on primary, explicit tasks that are the focus of effortful attention but have difficulty using information that occurs outside their focus of attention.

Because of the expected impact of psychopaths' cognitive functioning on their functioning in other domains, it is useful to examine the literature on psychopaths' cognitive and language function with an eye toward identifying principles that may play a broad role in psychopaths' processing style. In this regard, the preceding review has revealed two consistent themes that may lend insight into mechanisms underlying psychopathy. These themes involve poor accommodation of secondary or peripheral information when attention is focused elsewhere and unusual distribution of processing across the cerebral hemispheres. Next, we expand on these themes and consider their implications for understanding the syndrome of psychopathy.

Accommodation of Secondary Cues

As discussed throughout the preceding review, and consistent with multiple prior reviews (e.g., Newman, 1998) and theoretical statements (e.g., Newman & Wallace, 1993), many of the cognitive deficits exhibited by psychopaths are consistent with poor accommodation of secondary or unattended information. One influential perspective on this deficit has been provided by the response modulation hypothesis of Newman and colleagues (Newman, 1998; Newman & Wallace, 1993). Here, we briefly review the

evidence for poor accommodation of secondary information and then consider the potential relevance of this deficit to psychopaths' functioning in other, noncognitive, domains.

Before proceeding, it is useful to clarify the concept of secondary or unattended information. To this end, we find it helpful to invoke the concepts of top-down and bottom-up processing. Top-down, or voluntary, goal-directed processing is assumed to be capacity limited and to correspond to a dominant set, primary task, or effortful attention. Bottom-up, or stimulus-driven, processing is presumed to be involved in the processing of aspects of the internal or external environment that are not explicitly relevant to the ongoing task. Bottom-up processing proceeds without effortful attention and would include spreading activation among related neural networks. It is presumed that normal processing involves the continual reciprocal influence of top-down and bottom-up processes. Adaptive behavior is presumed to depend on an appropriate balance between top-down and bottom-up processes, such that top-down, deliberate processing is neither too vulnerable nor too insulated from the influence of unexpected bottom-up information (see Corbetta & Shulman, 2002, for further discussion). Using this framework, psychopaths' proposed difficulty accommodating secondary information can be understood as difficulty accommodating bottom-up, stimulus-driven information, especially when the bottom-up information is inconsistent with or unrelated to the current top-down, effortful focus of attention (see MacCoon, Wallace, & Newman, 2004, for further discussion).

Consistent with poor accommodation of unattended or bottom-up information, psychopaths' performance on attentional paradigms is associated with reduced physiological responsivity to irrelevant or secondary information (Jutai & Hare, 1983; Jutai et al., 1987), increased physiological reactivity to attended information (Forth & Hare, 1989), decreased interference from incongruent but irrelevant information that is spatially separated from the attentional focus (Hiatt et al., 2004; Newman, Schmitt, & Voss, 1997), and poor modulation of attention by unexpected emotional content (Christianson et al., 1996).

Psychopaths' language processing is also potentially consistent with poor accommodation of secondary, bottom-up information. Whereas control participants spontaneously use metaphor, affect, and elaborative associations when engaged in a linguistic task, psychopaths often fail to incorporate these secondary or contextual aspects of language, despite having good explicit awareness and understanding on direct examination (Hare et al., 1988; Lorenz & Newman, 2002; Williamson et al., 1991). Psychopaths also appear to have difficulty using abstract concepts (e.g., Kiehl, Hare, McDonald, & Brink, 1999), and their speech has less global cohesiveness than that of nonpsychopaths (Brinkley, Bernstein, & Newman, 1999; Brinkley, Newman, et al., 1999). Although the neural bases of these connotative and contextual components of language are not fully understood, it is reasonable to presume that they depend on broad activation of semantic networks, and that this activation typically proceeds in an automatic, bottom-up fashion.

On tests of behavioral inhibition, psychopaths routinely display deficits (i.e., commission errors) when the avoidance of punishable responses is secondary to an approach- or reward-based response contingency (e.g., Lykken, 1957; Newman et al., 1990; Newman & Kosson, 1986). Thus, psychopaths appear to have difficulty accommodating secondary or contextual cues that indicate the need to suspend responding and self-evaluate behavior when already engaged in a primary, goal-directed task.

The foregoing findings are quite consistent with regard to psychopaths' difficulty accommodating incidental information that occurs outside their focus of attention. Together, they suggest that poor accommodation of secondary or contextual information may be an important factor underlying psychopaths' processing deficits.

Given its prominence in the cognitive literature, this deficit might also be expected to moderate psychopaths' performance in other domains, such as emotion processing. Indeed, the foregoing review of cognitive deficits reveals several instances in which psychopaths have difficulty using affective information that is incidental to an ongoing task (e.g., Christianson et al., 1996; Hare et al., 1988; Lorenz & Newman, 2002; Wil-

liamson et al., 1991). Several of these same studies report evidence of good explicit use of emotional information. This "emotion paradox" is a common feature of psychopaths' emotion processing deficits (see Newman & Lorenz, 2003) and is consistent with good "top-down" but poor "bottom-up" use of affective information. In addition, imaging studies have identified abnormalities in the relative balance of top-down (e.g., frontal) and bottom-up (e.g., limbic) processing among psychopathic individuals (Kiehl et al., 2001; Muller et al., 2003) on emotion-processing tasks.

Psychopaths' difficulty accommodating bottom-up information can also be assumed to contribute to general difficulties with behavioral regulation. As mentioned earlier, the ability to maintain an appropriate balance between top-down and bottom-up processes is essential to adaptive executive control. If psychopaths are relatively insensitive to contextual information that occurs outside their top-down focus of attention, they can be expected to have difficulty interrupting or modifying ongoing behavior in response to cues that this behavior is no longer adaptive or appropriate (see MacCoon et al., 2004, for further discussion).

Hemispheric Processing

Another theme that emerges from the literature on psychopaths' cognitive deficits is the presence of unusual hemispheric processing. The existing studies reveal at least three components of this abnormality: (1) unusual cerebral processing asymmetries, (2) exacerbation of deficits under left-hemisphere activating conditions, and (3) context-specific failures to use information that is typically processed by the right hemisphere.

Cerebral Processing Asymmetries

As with psychopaths' attentional deficits, psychopaths' unusual processing asymmetries appear to occur only under particular conditions. Direct investigations of psychopaths' cerebral processing asymmetries have primarily used language-based tasks, and these studies indicate that psychopaths show abnormal asymmetries for word categorization, word detection, and oddball phoneme detection, but only when the task is relatively

complex (e.g., assigning words to abstract categories; detecting but also remembering dichotically presented words, and identifying rare targets when engaged in a concurrent distractor task). Together, these studies suggest that psychopaths' abnormal functional asymmetries may be specific to tasks that involve the integration of multiple task components. Hiatt and colleagues (2002) noted that task complexity has been shown to promote interhemispheric processing (Banich & Belger, 1990; Weissman & Banich, 2000), and they proposed that psychopaths' abnormal processing asymmetries may be related to the efficiency with which they can coordinate interhemispheric processing (see also Hare, 1998; Mills, 1995, as cited in Hare, 1998).

Left-Hemisphere Activation

Across several studies, Kosson and colleagues have demonstrated that psychopaths' attentional processing is disrupted under conditions that preferentially activate the left hemisphere (e.g., right-handed responses and RVF targets). Similarly, Howland and colleagues (1993) found that psychopaths had difficulty detecting LVF/right-hemisphere targets following misleading RVF/left-hemisphere cues. Interestingly, reward-seeking response sets may also preferentially engage the left hemisphere (Davidson, 1995; Miller & Tomarken, 2001; Sobotka et al., 1992), suggesting that the context-specificity of psychopaths' disinhibition and poor passive avoidance may be due in part to left hemisphere activation.

Poor Accommodation of Right-Hemisphere Processing

Psychopaths' performance on neuropsychological tests reveals deficits on several tasks that involve concurrent visuospatial processing and motor responses (e.g., TMT-B, Block Design, and Porteus Maze task). As visuospatial processing is believed to rely preferentially on the right hemisphere (Hellige, 1993), these deficits raise the possibility of right-hemisphere dysfunction. Interestingly, many of psychopaths' deficits in other domains are at least superficially consistent with right-hemisphere dysfunction. For example, the aspects of language overlooked

by psychopaths, such as metaphor, context, and connotations, are also dysfunctional among patients with right-hemisphere lesions (see Beeman, 1998; Fiore & Schooler, 1998). However, direct tests of psychopaths' right-hemisphere processing reveal no evidence of dysfunction (e.g., Day & Wong, 1996; Hiatt et al., 2002; LaPierre et al., 1995). It appears that psychopaths are most likely to show evidence of right-hemisphere dysfunction on tasks that involve concurrent goal-directed motor responses (e.g., Smith et al., 1992) or language processing (e.g., Hare et al., 1988). Goal-directed behaviors and language processing appear to rely preferentially on left-hemisphere processing, suggesting that psychopaths' deficits on right-hemisphere tasks, like their poor accommodation of secondary cues, may depend in part on the degree of concurrent left-hemisphere involvement.

It is not entirely clear how psychopaths' unusual cerebral processing asymmetries, sensitivity to left-hemisphere activation, and poor accommodation of right-hemisphere processing are related to each other. However, each of these abnormalities suggests a disruption in the coordination of processing across the cerebral hemispheres. One possibility is that psychopaths have difficulty efficiently integrating information across the cerebral hemispheres when the left hemisphere is strongly activated. A deficit of this sort could be expected to lead to an abnormal distribution of processing (i.e., unusual cerebral asymmetries) on tasks that normally elicit interhemispheric coordination (see Banich & Belger, 1990; Hiatt et al., 2002) as well as poor utilization of right-hemisphere processes under left-hemisphere activating conditions. As noted previously, psychopaths' deficits in language and visuospatial processing are potentially consistent with a context-specific failure to use right-hemisphere processing. Interestingly, the right hemisphere has also been implicated in emotion processing (Borod, Cicero, & Obler, 1998; Jansari, Tranel, & Adolphs, 2000; Lang, Bradley, & Cuthbert, 1990), behavioral inhibition (Davidson, 1995; Kawashima et al., 1996; Schiff & Bassel, 1996; Swartzburg, 1983), and attention to unexpected secondary cues (e.g., Corbetta & Shulman, 2002), suggesting that psychopaths' context-specific deficits in these domains may also be

consistent with poor utilization of right-hemisphere processing under left-hemisphere activating conditions (see also Hiatt & Newman, 2005).

The connections between psychopaths' cerebral processing abnormalities and their difficulty accommodating unattended secondary cues are especially intriguing and suggest that these two major components of psychopaths' cognitive deficits may arise from a common mechanism. Corbetta and Shulman (2002) argue that the "detection of behaviorally relevant stimuli, particularly when they are salient or unexpected" (p. 201) is largely lateralized to the right hemisphere, and they propose that this right-hemisphere based attentional system acts as a "circuit breaker" for top-down, goal-directed attentional systems. Thus, the right hemisphere may be particularly involved in the processing of secondary or unattended information. Psychopaths' context-specific failures to accommodate secondary or bottom-up information may therefore be closely related to psychopaths' difficulty using right-hemisphere processes under left-hemisphere activating conditions.

Regardless of the underlying mechanism, cerebral processing abnormalities appear to be a consistent feature of psychopaths' cognitive processing. Given the relative right-hemisphere lateralization of emotion processing, including startle responsivity (see, e.g., Bradley, Cuthbert, & Lang, 1991, 1996; Funayama, Grillon, Davis, & Phelps, 2001), cerebral processing abnormalities provide a potentially important link between psychopaths' cognitive and affective deficits.

SUMMARY

The literature on psychopaths' cognitive functioning is extensive and reveals a variety of consistent and compelling deficits. We have reviewed the existing findings with an eye toward identifying common themes that run throughout psychopaths' performance on cognitive tasks. Two major themes that emerge are difficulty accommodating secondary or bottom-up information and abnormal hemispheric processing. As noted previously, it is possible that these two broad deficits arise from a common mechanism. Regardless, each of these deficits appears to

have a strong influence upon psychopaths' cognitive processing, and each can also be expected to affect psychopaths' functioning in other domains, such as emotion processing. To the extent that these broad deficits apply to psychopaths' deficits in other, non-cognitive domains, they have the potential to lend coherence to the existing literature and promote greater understanding of the fundamental causes of the disorder.

It is intriguing that psychopaths' cognitive deficits do not fit established models of cognitive dysfunction, such as executive deficits or difficulty with sustained attention. Psychopaths appear to have adequate cognitive resources and capacity but difficulty maintaining an adaptive balance between top-down and bottom-up processing. The influence of bottom-up, automatic activation appears to be restricted among psychopaths when it is inconsistent with or occurs outside their top-down focus of attention. Currently, relatively little is known about how top-down and bottom-up networks interact. Nevertheless, psychopaths' cognitive functioning suggests that the mechanisms governing this interaction may play a central role in the psychopathic syndrome. Psychopaths' deficits also indicate that context-specific failures in the appropriate, adaptive allocation of available resources can contribute to profound failures of self-regulation, despite the absence of traditional cognitive or executive deficits.

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