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CHAPTER 29

Early Selective Attention Abnormalities in Psychopathy

Implications for Self-Regulation

Joseph P. Newman and Arielle R. Baskin-Sommers

Psychopathy has captured the interest of the lay public because people are fascinated by the idea of an individual whose behavior knows no bounds and has been described as a cold-blooded predator (Hare, 1996). Additionally, psychopaths' lack of inhibitory emotions (i.e., fear, guilt, remorse), disregard for social mores, obliviousness to the negative consequences of their actions, and antisocial lifestyle has attracted the interest of cognitive and affective neuroscientists. Although all of these characteristics represent important features of psychopathy, it is their affective deficits that distinguish psychopaths from other antisocial individuals and, perhaps for this reason, these deficits are commonly regarded as the root cause of psychopathy.

The seminal study in the field of psychopathy was published by David Lykken (1957). Lykken proposed that psychopaths are inherently fearless and that this fear deficit interferes with their ability to inhibit punished responses (i.e., passive avoidance). This low-fear proposal gave rise to one of the most long-lasting and influential theories in all of psychopathology. Consistent with this theory, psychopaths display poor fear conditioning (Lykken, 1957), minimal autonomic arousal in anticipation of aversive events (e.g., loud noises, electric shocks; Hare, 1978), problems learning to inhibit punished responses (Newman & Kosson, 1986), and a lack of startle potentiation while viewing unpleasant versus neutral pictures (Patrick, Bradley, & Lang, 1993). Moreover, there is preliminary evidence that psychopaths display less amygdala activation than controls during aversive conditioning (Birbaumer et al., 2005).

However, paralleling the emphasis on cognitive-emotional interactions in the broad neuroscience literature (e.g., Drevets & Raichle, 1998; Pessoa, Padmala, & Morland, 2005), there has been much debate as to whether the emotion deficits associated with psychopathy are absolute or moderated by attention[1] (e.g., Blair & Mitchell, 2009; Hare, 1978, 1986; Patrick et al., 1993; Newman, Curtin, Bertsch, & Baskin-Sommers, 2010). Our response modulation theory of psychopathy differs from traditional explanations that attribute psychopathy to a fundamental fear/emotion deficit and instead proposes that attention-related abnormalities underlie the emotion deficits and other features of psychopathy (MacCoon, Wallace, & Newman, 2004; Newman & Lorenz, 2003; Patterson & Newman, 1993).

In this chapter, we (1) present evidence that attention moderates the major behavioral and affective deficits in psychopathy; (2) specify the attentional abnormalities associated with psychopathy; (3) consider potential brain-based explanations for the attention-related abnormalities associated with psychopathy; and (4) clarify the implications of the attentional findings for the self-regulation deficits of psychopathic individuals.

Attention Moderates the Core Affective and Behavioral Deficits Associated with Psychopathy

According to the response modulation theory of psychopathy, attention plays a crucial role in moderating the affective and self-regulatory deficits associated with psychopathy. Response modulation involves the "temporary suspension of a dominant response set and a brief concurrent shift of attention from the organization and implementation of goal-directed responding to its evaluation" (Patterson & Newman, 1993, p. 717). In the absence of normal response modulation, an individual is prone to ignore crucial contextual information needed to evaluate behavior and exercise adaptive self-regulation (MacCoon et al., 2004; Newman, 1998). According to this view, psychopaths are oblivious to affective stimuli because they fail to reallocate attention to peripheral affective information while engaged in goal-directed behavior. This difficulty balancing demands to process goal-directed and peripheral information creates a bias whereby psychopaths are unresponsive to affective information unless it is a central aspect of their goal-directed focus of attention.

An important implication of the response modulation theory is that the fearlessness displayed by psychopathic individuals varies as a function of attentional focus. A recent experiment by Newman et al. (2010), involving fear-potentiated startle (FPS), provides striking support for this hypothesis. The task required participants to view and categorize letter stimuli that could also be used to predict the administration of electric shocks. Instructions served to activate goal-directed behavior that involved either a focus on threat-relevant information (i.e., the color that predicted electric shocks) or an alternative, threat-irrelevant dimension of the letter stimuli (i.e., upper/lower case of the letter or its match/mismatch in a two-back task). The results provided no evidence of a psychopathy-related deficit in FPS under conditions that focused attention on the threat-relevant dimension. However, psychopathy scores[2] were significantly and inversely related to FPS under conditions that required participants to focus on a threat-irrelevant dimension of stimuli (i.e., when threat cues were peripheral; Figure 29.1). A conceptual

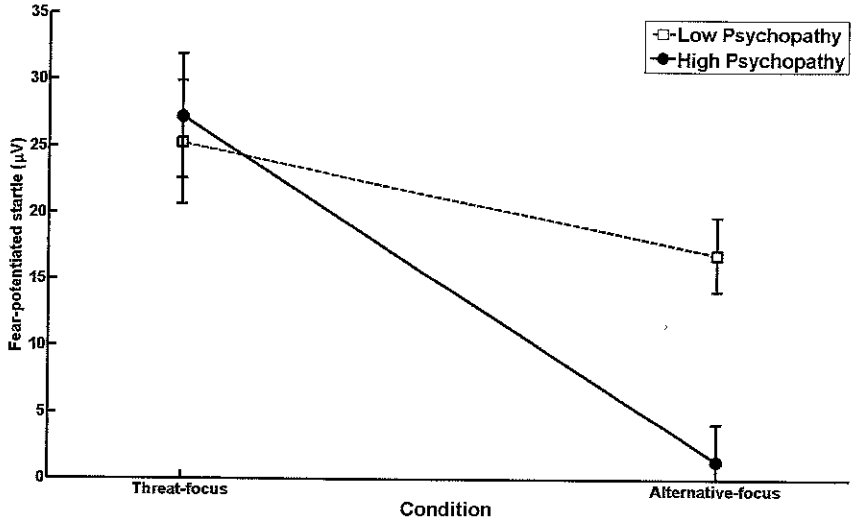

FIGURE 29.1. Fear-potentiated startle (FPS) as a function of psychopathy and condition (Newman et al., 2010). Focus of attention significantly moderated the psychopathy effect on FPS. Prisoners high on psychopathy displayed significantly lower FPS than prisoners low on psychopathy in the alternative-focus conditions. High- and low-psychopathy prisoners displayed comparable FPS in the threat-focus condition. FPS was calculated as startle response during red/threat minus green/neutral letter trials. FPS means displayed for low and high psychopathy were calculated at 1.5 standard deviations below and above the sample mean on the Hare (2003) Psychopathy Checklist—Revised, respectively. Error bars represent the standard error for the point estimate.

replication of this finding was recently reported by Baskin-Sommers, Curtin, and Newman (2011; details below).

Paralleling these findings for FPS, there is equally clear evidence that the classic inhibitory deficit associated with psychopathy is moderated by attention. Using a go/no-go discrimination learning task, Newman and Kosson (1986) examined passive avoidance under reward–punishment and punishment-only conditions. When participants were focused on avoiding punishment from the outset (punishment-only), there were no group differences in passive avoidance. However, when punishment was peripheral to the primary focus of earning rewards, psychopaths committed significantly more passive avoidance errors than controls (Figure 29.2). Thus, psychopaths' deficit in passive avoidance learning, like their FPS deficits, is moderated by their focus of attention (see also Newman, Patterson, Howland, & Nichols, 1990).

These and other findings provide compelling evidence that the fear and passive avoidance deficits associated with psychopathy are reliably moderated by focus of attention (see Newman & Lorenz, 2003). Given their demonstrated importance for understanding psychopathic behavior, it is crucial to specify these attentional effects and clarify how they limit the processing of contextual information.

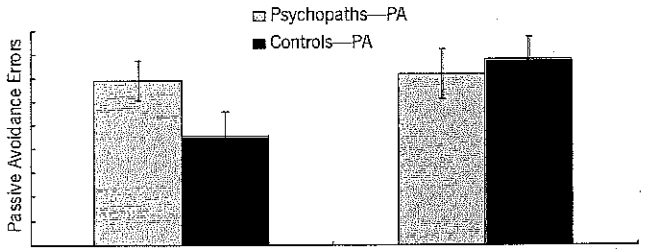

FIGURE 29.2. Passive avoidance learning as a function of psychopathy and condition (Newman & Kosson, 1986). Psychopathic offenders performed as well as nonpsychopathic offenders in the punishment-only condition, when avoiding punishment was participants' primary focus of attention. However, psychopaths committed significantly more passive avoidance errors than controls in the reward–punishment condition (punishment peripheral), when avoiding punishment required participants to inhibit a dominant response set for reward (see Newman et al., 1990). Psychopathic and nonpsychopathic offenders earned scores of 30 or more or 20 or less on Hare's (2003) Psychopathy Checklist—Revised, respectively.

Specifying the Attentional Abnormalities Associated with Psychopathy

Once psychopaths adopt a goal-directed focus of attention, they display a remarkable insensitivity to affective and inhibitory contextual information that might otherwise modulate their goal-directed behavior. One interpretation of this problem involves an abnormality in selective attention (Hiatt & Newman, 2006; Hiatt, Schmitt, & Newman, 2004). Clarifying the diverse mechanisms influencing selective attention is a primary focus of cognitive neuroscience, and terrific progress has been made (see Posner, 2004). Thus, the field provides a strong theoretical foundation for conceptualizing the selective attention abnormalities in psychopathy (Blair & Mitchell, 2009; MacCoon et al., 2004).

Selective attention is a multistage process that influences encoding, processing, and response selection. Historically, two stages have been identified as operating and influencing various aspects of information processing: early and late selection. Early selective attention is described as a "fixed bottleneck" that, once established, blocks the processing of secondary information that is not goal-relevant (Driver, 2001). Such selection is presumed to involve the serial processing of incoming information. Although this bottleneck has been associated with perceptual load (Lavie, Hirst, de Fockert, & Viding, 2004), there is also evidence that preperceptual filtering may be based on features such as spatial location and other visual properties available prior to stimulus identification (Anllo-Vento & Hillyard, 1996; Luck & Hillyard, 1999). Early attentional influences can affect neural activity in the visual cortex (Kastner & Ungerleider, 2000), filter the processing of sensory information (Hillyard, Vogel, & Luck, 1998), and prevent the perception of secondary information (Lavie et al., 2004).

Alternatively, selective attention may operate at a later stage (e.g., Luck & Hillyard, 1999). In traditional models of late selection, information is initially encoded in parallel and then selection occurs after stimulus identification or semantic encoding (Corbetta, Miezin, Dobmeyer, Shulman, & Petersen, 1991; Deutsch & Deutsch, 1963) and as a function of memory and response selection processes that bias attention in a manner consistent with a top-down, goal-directed focus (Driver, 2001). Late attentional influences are thought to occur primarily in frontal and parietal cortices (Kastner & Ungerleider, 2001) and to reflect a variety of processes, including both bottom-up and top-down influences on attention (Desimone, 1998).

This historical distinction between early and late selection is being reevaluated in light of difficulties associated with verifying discrete attentional stages (e.g., Driver, 2001) and the involvement of overlapping brain-related processes (e.g., Miller & Cohen, 2001). Such developments have resulted in a growing consensus that early and late influences on selective attention are better viewed as a continuum. Regardless of whether the stages of selective attention are viewed as continuous or discrete, we believe that the distinction between early and later influences remains an important one for psychopathy. Of particular relevance, the distinction highlights the extent to which selective attention reflects a relatively automatic gating out of distracting stimuli as opposed to the influence of higher-order regulatory processes that sustain a goal-relevant focus of attention. In the former case, an attention bottleneck may automatically undermine the meaningful identification of peripheral stimuli to the point where they have minimal impact on behavior. In the latter case, peripheral stimuli are fully identified, with the result that minimizing their influence on behavior requires executive attention and working memory capacity (Lavie et al., 2004; Posner & Rothbart, 2009; Vogel, Woodman, & Luck, 2005). Thus, cognitive control and working memory capacity are distinctly important at later stages of selective attention (Knudsen, 2007).

Apart from the early and later stage influences on selective attention, it is also important to highlight the partially independent effects of higher-order executive functions, such as working memory and cognitive control, on selective attention (e.g., Knudsen, 2007). According to Miller and Cohen (2001), executive functions are instantiated in prefrontal cortex and influence selective attention by increasing the competitive gain of neurons associated with goal-relevant as opposed to distracting stimuli. The information that gains dominance enters into working memory and, accordingly "controls top-down signals that modulate the sensitivity of neural representations that contribute to that information" (Knudsen, 2007, p. 58). Thus, it is possible that the attentional effects associated with psychopathy stem from an executive level, rather than from an early attentional bottleneck. In fact, most cognitive explanations for disinhibitory psychopathology have focused primarily on the importance of working memory capacity and other executive functions for inhibiting prepotent affective, cognitive, and behavioral responses (Giancola & Tarter, 1999; Morgan & Lilienfeld, 2000; Patrick, 2008; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). For this reason, we first address the quality of executive functioning in psychopathy. However, our research with psychopathic offenders leads us to propose that psychopathy involves an early attentional bottleneck that interferes with the processing of information that is incongruent with a current goal rather than limitations in later stages of selection, particularly as they relate to executive functions.

Executive Functioning in Psychopathy

Executive functioning "is broadly defined as comprising the abilities needed to achieve and maintain a problem-solving set, and includes such processes as planning, organizational

skills, selective attention and inhibitory control, and optimal cognitive-set maintenance" (Morgan & Lilienfeld, 2000, p. 114). Given the pervasive failure of psychopaths and other disinhibited individuals to inhibit inappropriate prepotent responses, it is reasonable to expect that a deficiency in executive functioning underlies such behavior. In our view, however, this model is better suited to understanding the inhibitory problems associated with externalizing psychopathology (i.e., conduct disorder, adult antisocial behavior, alcohol dependence, drug dependence) and its associated trait dimensions (i.e., low constraint, high negative emotionality) than to psychopathy (MacCoon et al., 2004; Patrick & Bernat, 2010). A variety of evidence supports the association between executive functioning deficits and general antisocial behavior (e.g., Bernat, Nelson, Steele, Gehring, & Patrick, 2011; Howard & McCullagh, 2007; Morgan & Lilienfeld, 2000), but the evidence for a specific association with psychopathy is much less compelling.

When psychopathic offenders are identified using Hare's (2003) Psychopathy Checklist—Revised, the gold-standard assessment of psychopathy, they rarely display deficits on standard measures of neuropsychological functioning (Hart, Forth, & Hare, 1990; Smith, Arnett, & Newman, 1992; cf. Pham, Vanderstukken, Philippot, & Vanderlinden, 2003), cognitive control (Blair et al., 2006; Hiatt et al., 2004; Munro et al., 2007), or error detection (Munro et al., 2007; cf. von Borries et al., 2010). Despite using a version of the Stroop task that is differentially associated with anterior cingulate cortex (ACC) activation in neuroimaging studies (Carter et al., 2000), Dvorak-Bertsch, Sadeh, Glass, Thornton, and Newman (2007) were also unable to find evidence of cognitive control deficits in psychopathy. More generally, psychopaths rarely display response inhibition deficits when the requirement to inhibit prepotent responses is explicit (Arnett, Smith, & Newman, 1997; Newman et al., 1990; Newman, Widom, & Nathan, 1985; Newman, Schmitt, & Voss, 1997). Rather, psychopaths' inhibitory deficits become apparent primarily when inhibitory cues are latent, incongruent with, or peripheral to their primary focus of attention (Lykken, 1957; Hiatt & Newman, 2006). In such cases, their tendency to focus on goal-relevant information to the exclusion of peripheral information gives the appearance of superior rather than inferior cognitive control. However, there is also little evidence that their unusual selective attention is associated with superior cognitive control or motivational factors such as exaggerated reward sensitivity (Hiatt & Newman, 2006; Newman, 1997). Overall, research on executive functioning in psychopathy provides little reason to believe that abnormalities in higher-order cognitive processes underlie the abnormal selective attention and the response modulation deficits of psychopathic individuals (cf. Blair, Mitchell, & Blair, 2005). Next, we consider whether some sort of early attentional "bottleneck" limits the processing of secondary information in psychopathic individuals.

Early Selection in Psychopathy: Evidence Involving Emotion Stimuli

Early selection reduces the influence of peripheral information using filters that bias conscious perception (Lavie et al., 2004; Pessoa et al., 2005; Pessoa & Ungerleider, 2005; Vogel et al., 2005). In this regard, early selection resembles response modulation deficits in that individuals remain oblivious to a variety of potentially important stimuli unless they are a central aspect of their prepotent focus of attention. With the distinction between early and late selection in mind, Baskin-Sommers et al. (2011) attempted to specify the attentional mechanism that moderates the fearlessness of psychopathic

offenders. First, the authors replicated the key findings reported by Newman et al. (2010) using a different sample of offenders and a new instructed fear paradigm. Specifically, they found that psychopaths' deficit in FPS was pronounced when threat-relevant cues were peripheral to their primary focus of attention (i.e., alternative-focus condition), but it was virtually nonexistent under conditions that focused attention on the threat-relevant dimension of the experimental stimuli (i.e., threat-focus condition). In order to evaluate early versus late influences on selective attention, the authors manipulated the timing of the threat cues, so that they appeared either before or after the threat-irrelevant information on each trial. Statistical contrasts demonstrated that the fear deficit of psychopathic offenders was specific to the alternative-focus condition that involved presenting the goal-relevant information prior to the threat-relevant information. According to the authors, the results implicate early selective attention as a proximal mechanism for deficient response modulation in psychopathy.

To evaluate and further specify the hypothesis of an early attentional bottleneck that filters distracting information, Baskin-Sommers, Curtin, Li, and Newman (in press) used event-related potential (ERP) data collected during the Newman et al. (2010) FPS study. Looking for the earliest psychopathy-related difference, the authors found that psychopathy scores were significantly and positively associated with P140 responses in the alternative-focus condition. Conversely, psychopathy scores were nonsignificantly, but negatively, associated with P140 in the threat-focus condition. Moreover, the significant three-way interaction indicated that these effects were specific to trials involving the red (i.e., threat) as opposed to green (i.e., safe) letter stimuli (Figure 29.3). These data provide further evidence that psychopathy involves anomalies in early selective attention and that such anomalies may reduce attention to even highly salient peripheral stimuli. As predicted by the response modulation theory (Patterson & Newman, 1993), psychopathy appears to be associated with abnormalities in early selective attention, which, in turn, reduce reactivity to peripheral emotion-related cues that normally modulate goal-directed behavior.

These recent findings implicate an early attentional bottleneck that limits processing of peripheral threat cues in psychopathy. However, the fact that psychopaths display emotion-modulated startle deficits in picture-viewing paradigms, despite explicit instructions to stay focused on the pictures appears more compatible with a fundamental emotion deficit. In contrast to controls, who display greater startle responses to noise probes while viewing unpleasant versus neutral pictures, this startle potentiation appears to be lacking in psychopathic participants (see Patrick, 1994). Such findings are generally interpreted as evidence that psychopaths are insensitive to the negative affect engendered by unpleasant pictures. However, there is evidence that this deficit is time limited. Specifically, psychopaths display startle potentiation deficits when probes are presented shortly after picture onset (e.g., 1.5 s), but they display normal emotion-modulated startle when probes are presented later in the picture-viewing interval (e.g., 4 s; Levenston, Patrick, Bradley. & Lang, 2000; Sutton, Vitale, & Newman, 2002).

In an attempt to reconcile the attentional bottleneck and emotion deficit interpretations, it is interesting to speculate about the role of an attentional bottleneck in the processing of picture stimuli. Picture processing initially elicits attentional responses that inhibit emotion-modulated startle (e.g., Bradley, Hamby, Low, & Lang, 2007). To the extent that psychopathy involves an attentional bottleneck that constrains the simultaneous processing of picture elements, the emotion-modulated startle of psychopathic

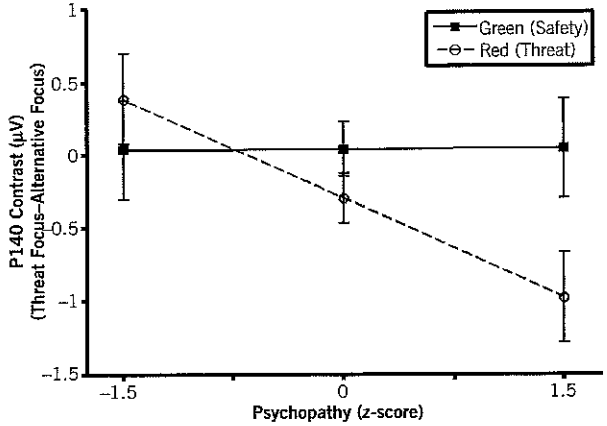

FIGURE 29.3. P140 difference scores as a function of psychopathy, color, and condition. P140 difference scores were computed by subtracting P140 during alternative focus (AF) conditions from P140 during the threat focus (TF) conditions. Positive difference scores reflect greater P140 during TF than during AF, whereas negative difference scores reflect greater P140 during AF than during TF. The three-way interaction revealed that the psychopathy-related effects were specific to red-letter trials, when participants' goal-directed focus competed with threat of imminent shock. During red trials, participants with low psychopathy scores displayed roughly comparable P140 responses regardless of condition. However, the P140 responses of psychopathic participants on red-letter trials were significantly larger under AF than under TF conditions (i.e., negative difference score), suggesting less distraction and greater goal-directed focus under AF conditions.

individuals would be delayed relative to controls. However, given enough time to process the pictures, limitations associated with the attentional bottleneck would abate, and psychopaths would show normal emotion-modulated startle (cf. Funayama, Grillon, Davis & Phelps, 2001).

The time-limited effect of an attentional bottleneck may also explain psychopaths' paradoxical performance on measures of emotion facilitation derived from lexical decision tasks. A substantial literature shows that lexical decisions are faster and more accurate for words that have affective connotations than for neutral words. This phenomenon is relatively absent in psychopathic offenders (Lorenz & Newman, 2002; Williamson, Harpur, & Hare, 1991) but, paradoxically, postexperiment evaluations reveal comparable affective ratings and facilitated memory for emotion words in both psychopathic and nonpsychopathic participants (see also Kiehl et al., 2001). Such findings may indicate that psychopaths are sensitive to the affective qualities of the words, but that these affective connotations have minimal impact on their performance while they are engaged in goal-directed behavior, owing to the putative bottleneck (see also Glass & Newman, 2009).

Although recent evidence for an attentional bottleneck that curtails emotion processing is compelling, others have proposed that psychopaths are less likely to redirect attention to emotion cues because a fundamental amygdala-mediated emotion deficit undermines their motivation or capacity to do so (Blair & Mitchell, 2009; Lykken, 1995). While such proposals acknowledge the importance of attention–emotion interactions,

they attribute the attentional abnormalities to a fundamental emotion deficit. In light of these alternative proposals, it is important to consider the substantial evidence demonstrating that psychopaths display similar attentional abnormalities on laboratory tasks involving motivationally neutral peripheral information.

Early Selection in Psychopathy: Evidence Involving Motivationally Neutral Stimuli

In standard versions of the color-word and number Stroop tasks, participants first perceive the conflicting elements and must then reprioritize attention to the appropriate element of the display (MacLeod, 1998). Thus, the quality of one's response depends on the ability to resolve the conflict (i.e., cognitive control) prior to making a response. Under such conditions, psychopathic individuals show normal levels of interference (Blair et al., 2006; Hiatt et al., 2004; Smith et al., 1992). Conversely, on Stroop-like tasks that facilitate early selection of goal-relevant information by spatially or temporally separating the incongruent elements of the display, psychopathic individuals display significantly less interference than nonpsychopathic individuals (Hiatt et al., 2004; Mitchell, Richell, Leonard, & Blair, 2006, Newman, Schmitt, et al., 1997; Vitale, Brinkley, Hiatt, & Newman, 2007). In essence, these modified Stroop paradigms allow participants to exercise early selection and, to the extent that early selection reduces the salience of the conflict, the need for cognitive control is minimized.

Corroborating this interpretation of the Stroop data, Zeier, Maxwell, and Newman (2009) used a modified Erikson flanker task with an attentional cueing manipulation to examine whether early selective attention is a crucial factor differentiating sensitivity to response conflict in psychopathic individuals. On some trials, pretrial cueing was used so that participants could orient attention to the location of the task-relevant target before the target and distracting flanker stimuli were presented. On other trials, the pretrial cues directed attention to both the target and distracter locations and thus increased demands for cognitive control. Whereas psychopathic participants displayed significantly less interference than controls in the early selection condition, they displayed nonsignificantly more interference in the condition that cued both target and distracter locations. Combined, these studies show that psychopathic participants are significantly less sensitive to information if it is peripheral to a pre-established focus of goal-directed behavior. Moreover, the fact that this abnormality applies to affectively neutral as well as affectively significant peripheral information implicates an early attentional bottleneck that undermines the processing of goal-incongruent cues regardless of affective significance (see also Hiatt et al., 2004; Mitchell et al., 2006; Vitale et al., 2007; Jutai & Hare, 1983).

A study by Hiatt et al. (2004) provides relatively unique evidence that an attentional bottleneck limits information processing in psychopathy. Using a Stroop-like task in which participants named the color of a centrally presented rectangle while ignoring letter stimuli presented inside the rectangle, Hiatt et al. found that psychopaths displayed significantly less interference than controls when the letters spelled incongruent color words versus nonwords (see Figure 29.4). Yet, psychopaths and controls displayed comparable facilitation when the color words were congruent with the color of the rectangle. As speculated above with regard to affective pictures and words, these findings suggest that psychopaths register peripheral stimuli but that their online (i.e., in the moment) processing of contextual information is minimal. To the extent that the contextual information

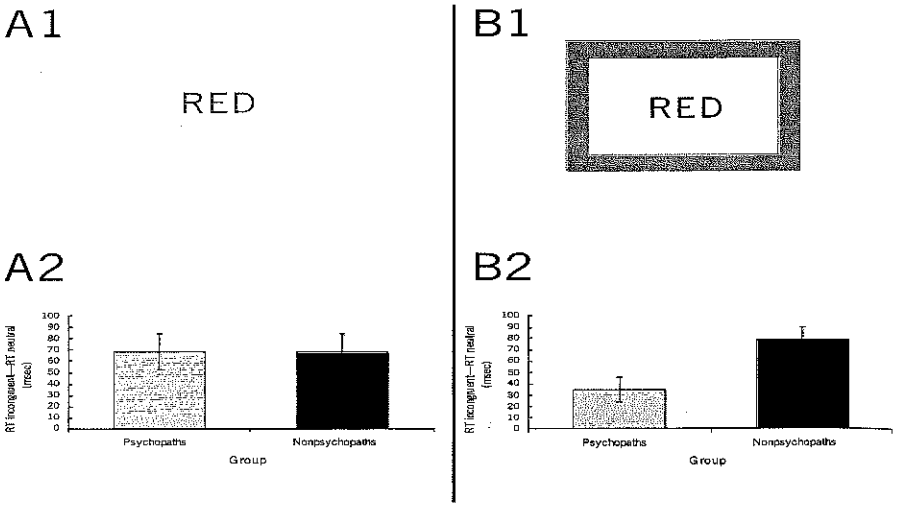

FIGURE 29.4. Stroop interference as a function of psychopathy in a standard color-word Stroop task (Experiment 1) and in a Stroop-like task designed to spatially separate the incongruent elements of the color-word display (Experiment 3; Hiatt et al., 2004). Although gray in panel A1, the words actually appeared in red, blue, green, and yellow. Similarly, although the rectangle and color word in panel B1 are shown in gray and black, respectively, the rectangles were actually red, blue, green, and yellow, and the words appeared in white. Psychopathic and nonpsychopathic offenders displayed comparable interference in the spatially integrated task (A1 and A2), which is believed to measure late selective attention (MacLeod, 1998). However, psychopaths displayed significantly less interference than controls (i.e., superior performance) in the spatially separated task (B1 and B2), which afforded participants more opportunity for early selective attention. Psychopathic and nonpsychopathic offenders earned scores of 30 or more or 20 or less on Hare's (2003) Psychopathy Checklist—Revised, respectively.

is congruent with their primary focus, and therefore does not require modulating a prepotent focus of attention, psychopaths appear to be normally responsive to bottom-up cues. However, when bottom-up cues are incongruent with their top-down focus so that processing the information requires response modulation, psychopaths appear oblivious to such information. In light of reliable evidence that attention moderates the inhibitory (Zeier et al., 2009), affective (Newman et al., 2010), and self-regulation (Newman & Kosson, 1986) deficits associated with psychopathy, we believe that it is crucial for future research to specify the cognitive–affective networks responsible for the response modulation deficits of psychopathic individuals.

Potential Brain-Based Explanations for the Attention-Related Bottleneck in Psychopathy

The response modulation theory of psychopathy highlights psychopaths' difficulty with suspending top-down mediated goal-directed behavior to accommodate bottom-up cues (i.e., a deficit in top-down–bottom-up integration). Moreover, our research has specified

the nature of the selective attentional deficit in psychopathy. Nevertheless, the complex array of neural processes that interacts to influence selective attention makes it difficult to specify the source of psychopaths' dysfunction. Plausible mechanisms are thus quite diverse and include deficiencies in bottom-up activation, a top-down attentional bottleneck, and other problems that undermine top-down–bottom-up integration. In light of the longstanding emphasis on psychopaths' fear deficit, brain-based explanations for psychopathy have tended to emphasize amygdala dysfunction (Blair, 2007; Patrick, 2007). Such bottom-up proposals are compelling for a number of reasons but, in light of evidence that psychopaths' response modulation deficits are not specific to peripheral emotion cues (e.g., Stroop conflict), it is important to clarify whether such proposals are specific to emotion cues or apply to the salience of bottom-up cues more generally.

Regarding a potential top-down mechanism for psychopaths' response modulation deficits, Dux, Ivanoff, Asplund, and Marois (2006) have identified a central "bottleneck" located in the left posterior lateral prefrontal cortex (Dux et al., 2006; Marois & Ivanoff, 2005). They note that in contrast to perceptual and motor stages of information processing for multiple tasks that can proceed in parallel, other information-processing tasks reflect a central bottleneck. The bottleneck reflects the fact that a serial queuing of response selection occurs when multiple tasks involve overlapping processes (Pashler, 1998). A left-hemisphere-dominant bottleneck of this type may explain why psychopaths are able to process two streams of information when both are directly related to the top-down goal. However, when there are competing goals or incongruent information, psychopaths are forced to process information more sequentially. It is also consistent with evidence that psychopaths' processing of negative feedback improves significantly under conditions that (1) interrupt their goal-directed behavior, (2) provide additional time to process response feedback, or (3) employ response feedback that overlaps with goal-relevant expectations (Arnett, Howland, Smith & Newman, 1993; Arnett et al., 1997; Newman et al., 1990; Newman, Patterson, & Kosson, 1987). Moreover, to the extent that a central bottleneck of this type inhibits/delays the transfer of bottom-up information from right-hemisphere networks, it might also explain why psychopaths display a deficit in emotion facilitation when making lexical decisions with their right hand yet display normal emotion facilitation when responding with their left hand (i.e., bypassing the left-hemisphere bottleneck; Lorenz & Newman, 2002).

Finally, it is interesting to speculate that an information-processing deficit involving such a bottleneck would simultaneously increase the costs of distraction and facilitate the ease with which distractions could be ignored. Given such circumstances, psychopaths may be especially predisposed to and adept at "gating out" distracting information. In this regard, Dolcos, Kragel, Wang, and McCarthy (2006) proposed that "coping with emotional distraction entails interactions between brain regions responsible for detection and inhibition of emotional distraction, and identified a hemispheric specialization in the inferior frontal cortex in controlling the impact of distracting emotions on cognitive performance (left hemisphere)" (p. 1591). In light of this proposal, it might be noteworthy that psychopathic criminals displayed widespread activation deficits in paralimbic structures while attempting to learn and recall affective words, yet they displayed significant overactivation in inferior frontal cortex (Kiehl et al., 2001). Such findings are consistent with the possibility that psychopaths' time-limited insensitivity to affective information (e.g., Levenston et al., 2000; Sutton et al., 2002) reflects a relatively automatic coping response that serves to "gate out" (Hare, 1978) distracting information and increase attention to goal-directed behavior at an early stage in the information-processing stream.

In light of our interest in identifying a potential neural substrate for the attentional bottleneck in psychopathy, it is tempting to consider the left posterior lateral prefrontal cortex (pLPFC) highlighted by Dux and colleagues (2006). However, the neural networks comprising the bottleneck have yet to be fully elaborated. Of particular interest, Dux and colleagues note that the pLPFC interacts with the superior medial frontal cortex, and that these interactions appear to be especially important under conditions involving increased processing demands (see Dux et al., Experiment 2). Given the fundamental association between the superior medial frontal cortex and cognitive control (e.g., Botvinick, Cohen, & Carter, 2004; Miller & Cohen, 2001; Rueda, Posner, & Rothbart, 2005), it may be that pLPFC is part of a network that plays a role at multiple stages of selective attention.

Another potential explanation for the response modulation deficits in psychopathy involves Corbetta, Patel, and Shulman's (2008; Corbetta & Shulman, 2002) "reorienting system of the human brain," which emphasizes the integration of top-down and bottom-up processes. In this model, two networks balance the demands of complex attentional contexts. According to Corbetta and colleagues, a dorsal parietal network facilitates goal-directed attention (i.e., top-down attention) and associated behavioral (motor) responses. Conversely, a right-hemisphere-dominant ventral parietal network (i.e., bottom-up attention) notices unattended stimuli in the environment that may be salient or behaviorally important. These systems interact to achieve an appropriate balance between attending to top-down goal-directed signals and bottom-up information within a given context. Under conditions where goal-directed attention is established, the ventral system is generally suppressed by the dorsal system. Nevertheless, the ventral attentional network can act like a circuit breaker to reset the dorsal system when it encounters salient and behaviorally relevant stimuli in the environment.

The correspondence between Corbetta et al.'s (2008) model and laboratory evidence on psychopaths' response modulation deficits is remarkable.[3] In addition to the key attentional findings described above, psychopathic individuals display:

- A failure to pause and reflect in response to unexpected negative feedback while engaged in goal-directed behavior (Newman et al., 1990)
- A breakdown in the ability to link primary task-relevant stimuli with contextual cues such as their location or color (Bernstein, Newman, Wallace & Luh, 2000; Glass & Newman, 2009)
- Normal perceptual asymmetries on tasks involving concrete information (e.g., words) but abnormal asymmetries on tasks that require integration of information from the left and right hemispheres (e.g., Kiehl et al., 2004; Lorenz & Newman, 2002)
- Deficits in interhemispheric transfer of information, particularly from right to left hemisphere (Hiatt & Newman, 2007)
- A problem reorienting attention to targets in the left visual field on trials that cue attention to the right visual field (Howland, Kosson, Patterson, & Newman, 1993).

The latter study employed the very paradigm (i.e., Posner, 1980) that Corbetta et al. used to illustrate their points. The overall pattern of results suggests a deficiency that corresponds to a lack of communication between Corbetta et al.'s right-hemisphere-dominant ventral parietal network and the dorsal parietal network that mediates goal-directed attention.

The application of Corbetta et al.'s (2008) reorienting system to psychopathy also fits well with neuroimaging data showing that brain abnormalities in psychopathy extend far beyond the amygdala complex. For instance, Kiehl (2006) noted widespread hypoactivation in diverse limbic and paralimbic structures, including the orbital frontal cortex, insula, anterior and posterior cingulate, amygdala, parahippocampal gyrus, and anterior superior temporal gyrus. The structures identified by Kiehl overlap with Corbetta et al.'s reorienting network. For example, the superior temporal gyrus is one region associated with ventral processing, and the insula, specifically anterior insula, has been described as key to coordinating task performance in the ventral system (Eckert, et al., 2008). A meta-analysis of structural and functional imaging of psychopathic and antisocial individuals conducted by Yang and Raine (2009) concluded that significant effect sizes were localized to the right orbitofrontal cortex (OFC), right anterior cingulate cortex (ACC), and left dorsolateral prefrontal cortex (dLPFC). These regions also play a central role in the reorienting network (Corbetta et al., 2008); specifically, bilateral dLPFC and right ACC have been associated with dorsal and ventral processing, respectively (Eckert et al., 2008). Furthermore, right OFC and ACC play key roles in processing secondary cues, including those affecting emotion processing and decision making, which, if damaged, would fail to direct attention to important information in the right hemisphere when needed (Glenn & Raine, 2008). This focus on the integration of secondary information is also in line with the response modulation model and a report by Hiatt and Newman (2007) involving interhemispheric integration deficits in psychopathy.

Although space limitations preclude elaboration, it is worth noting that these potential mechanisms are not mutually exclusive. As noted above, a specific attentional bottleneck of the type described by Dux and colleagues (2006) could undermine interhemispheric integration in psychopathy by making it more difficult to accommodate affective and inhibitory information processed primarily by the right hemisphere. Conversely, because interhemispheric integration facilitates parallel processing, and thereby the processing of multifaceted information (Weissman & Banich, 2000), a deficit in interhemispheric integration could increase demands for the serial processing of information and contribute to an attentional bottleneck. Moreover, it is possible that a deficiency in amygdala activation that undermines attentional alerting and orienting would interfere with reorienting attention to potentially significant bottom-up stimuli (Williams et al., 2007). Given the tentative nature of our proposals regarding the selective attentional deficits in psychopathy, it is clearly premature to draw firm conclusions regarding the neurological substrate of these deficits. Instead, our goal here is to clarify the type of brain-related processes that might account for the selective attentional abnormalities associated with psychopathy and highlight the potential merits of exploring attention-related, as well as emotion-focused, neural substrates for psychopathy.

Self-Regulation as the Context-Appropriate Balance of Attention

To date, cognitive neuroscience approaches to self-regulation have focused predominantly on the ability to remain focused on goal-directed behavior and to screen out distracters (i.e., executive functioning; Banfield, Wyland, Macrae, Munte, & Heatherton, 2004; Rueda et al., 2005). Although psychopaths display profound deficits in self-regulation,

they do not appear to be deficient in this regard. To the contrary, once attention is engaged in goal-directed behavior, their focus is abnormally resistant to the influence by peripheral information that routinely modulates the goal-directed behavior of others. In other words, psychopathy appears to reflect abnormalities at an earlier stage of selective attention. This distinction serves to differentiate the self-regulation deficits associated with psychopathy from those associated with other syndromes of disinhibition that involve cognitive control and other executive function deficits (e.g., attention-deficit/hyperactivity disorder, early-onset substance abuse, and most other forms of impulsivity; Iacono, Malone, & McGue, 2008).

Owing to our interest in distinguishing relatively automatic and higher-order influences on self-regulation, our lab has conceptualized self-regulation as the context-appropriate balance of top-down and bottom-up influences on attention (CABA; MacCoon et al., 2004). According to the CABA model, particular thoughts, affects, and behaviors are conceptualized as networks of coactivated neurons in the brain. Much like Corbetta et al. (2008), the CABA model highlights the fact that the appropriate balance of attention to dominant (i.e., top-down, prepotent) and nondominant (i.e., bottom-up, peripheral) cues depends on the particular context. Moreover, early selective attention and executive functioning can impact self-regulation in different ways.

On the one hand, in contexts in which there are competing goals, a deficit in cognitive control will hamper a person's ability to select (i.e., bias attention toward) a context-appropriate, but nondominant, goal instead of a prepotent, but less appropriate one. On the other hand, in contexts where the goal is ambiguous or response modulation is required for some other reason, an abnormality in early selection would undermine the processing of peripheral information and preclude an adaptive shift in behavior. That is, to the extent that bottom-up cues fail to compete with top-down goal-directed responses, an individual's ability for deliberate self-regulation would be greatly diminished regardless of the general ability to exercise cognitive control. Thus, in contrast to executive functioning deficits that hamper the quality of self-regulation, early selection abnormalities of the type associated with psychopathy may preclude the initiation of self-regulation altogether (see Figure 29.5).

We believe that this distinction between the self-regulation deficits of psychopaths and those associated with other externalizing psychopathology has important implications for the differential treatment of these disorders. In light of rapidly developing interest in the use of cognitive remediation to address self-destructive behavior (e.g., substance abuse), such distinctions may be crucial for designing cognitive interventions that address the specific cognitive deficits of phenotypically similar, but etiologically distinct, groups. In conjunction with collaborators, we have begun to investigate cognitive interventions that we believe will be differentially effective in treating the self-regulation and substance abuse problems associated with psychopathy versus other criminal subtypes.

In summary, we have presented evidence suggesting that psychopaths' insensitivity to bottom-up affective and inhibitory information reflects an attentional bottleneck involving early selective attention. To support the biological plausibility of this response modulation deficit, we have described alternative neural mechanisms that could explain this attentional bottleneck. In addition, we have used the CABA model to both clarify the implications of an early selection abnormality for self-regulation and to distinguish this problem from more common explanations involving deficits in executive functioning. Lastly, we have proposed that this differentiation might be crucial for distinguishing

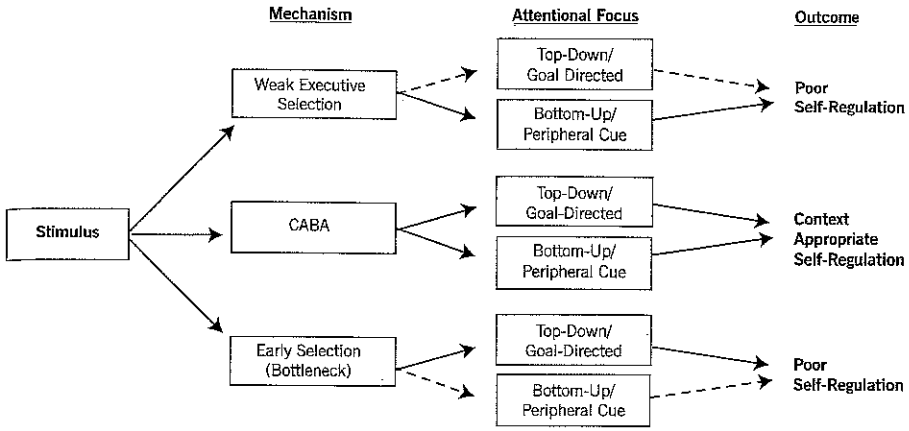

FIGURE 29.5. Schematic illustrating the importance of a context appropriate balance of attention between top-down and bottom-up activation for self-regulation (MacCoon et al., 2004). Solid and dotted lines indicate activation that is either sufficient or insufficient to influence goal-directed behavior. The effect of any stimulus will depend on individual differences. Adaptive self-regulation is facilitated by a contextualized balance of attention (i.e., CABA) between top-down and bottom-up influences on behavior. Weak executive selection undermines top-down control (i.e., dotted lines) and results in a reactive and unregulated expression of bottom-up responses. An early selection bottleneck undermines the effects of bottom-up activation (i.e., dotted lines) that might otherwise modulate top-down goal-directed behavior, resulting in inflexible, poorly informed goal-directed behavior.

the information-processing deficits associated with psychopathy from those of other disinhibited groups and, thus, for developing specific cognitive remediation strategies to address their respective deficits.

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NOTES

1. We recognize that attentional and emotional processes are inextricably related in normal emotion processing. Nevertheless, in seeking to identify the variable or variables that undermine normal emotion processing in psychopathy, it may be possible to identify the differential contribution of particular variables to the psychopathic deficit.

2. In all of the studies reported in this chapter, psychopathy is assessed using Hare's (2003) Psychopathy Checklist—Revised (PCL-R), which is regarded as the state-of-the-art measure of psychopathy owing to the demonstrated reliability and validity of PCL-R ratings.

3. We acknowledge Aaron Heller's assistance in elaborating the potential relevance of Corbetta and Shulman's model for the response modulation deficits of psychopathic individuals.

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CHAPTER 30

Attentional Impairments in Children with Chromosome 22q11.2 Deletion Syndrome

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Chromosome 22q11.2 deletion syndrome (22q11.2DS) results from a fairly common, predominantly de novo, interstitial microdeletion of 1.5 to 3 million base pairs on the long (q) arm of chromosome 22 that includes 30–40 genes, including catechol-O-methyltransferase (COMT) and proline-dehydrogenase (PRODH). Thought to have a prevalence of around 1:4,000 live births (Tézenas Du Montcel, Mendizabai, et al., 1996; Oskarsdottir, Vujic, et al., 2004), 22q11.2DS encompasses DiGeorge and Velocardiofacial syndromes, among others (Driscoll, Salvin, et al., 1993). It presents with a complex, variable phenotype (Shprintzen, 2008) that includes congenital heart defects, immune dysregulation, cleft palate, low muscle tone, and a host of other medical complications. Some of the most penetrant manifestations of 22q11.2DS are cognitive, behavioral, and psychiatric (Shprintzen, 2000; Campbell & Swillen, 2005; Simon, Bish, et al., 2005; Simon, Burg-Malki, et al., 2007). Learning difficulties, predominantly in nonverbal and numerical domains, attention-deficit disorders, and anxiety disorders are particularly common in children, and the risk for schizophrenia in late adolescence and adulthood is around 30 times greater than in the general population (Feinstein, Eliez, et al., 2002; Baker & Skuse, 2005; Gothelf, Feinstein, et al., 2007; Green, Gothelf, et al., 2009). Simon (2008) recently proposed that many of the cognitive impairments seen in children with 22q11.2DS are rooted in attentional dysfunction, which "creates a suboptimal foundation for the subsequent development of numerical and mathematical competence, thereby 'cascading' impairments into those more academic domains" (p. 52). That is, an early impairment in attention could disrupt the typical developmental course of higher cognitive functions,