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Self-Regulation: Context-Appropriate Balanced Attention

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In this chapter, we discuss a broad self-regulatory framework in which self-regulation is defined as the context-appropriate allocation of attentional capacity to dominant and nondominant cues. We use the response modulation hypothesis (RMH; Patterson & Newman, 1993) and neural network language to clarify this definition, to argue that the definition captures essential characteristics of self-regulation, to discuss the neurobiological plausibility of our perspective, and to demonstrate the generalizability and relevance of the perspective by applying it to psychopathy, self-discrepancies, eating disorders, neuroticism and extraversion, and acute alcohol consumption. To distinguish this updated framework from the original RMH, we refer to it as the context-appropriate balanced attention (CABA) framework.

SELF-REGULATION: THE CONTEXT-APPROPRIATE ALLOCATION OF ATTENTIONAL CAPACITY TO DOMINANT AND NONDOMINANT CUES

Our definition of self-regulation views limited-capacity, selective attention as a key self-regulatory mechanism. Consistent with this point of view, many perspectives on self-regulation highlight the role of attention (e.g., Baumeister & Heatherton, 1996; Carver & Scheier, 1981; Cohen, Botvinick, & Carter, 2000; Cohen, Dunbar, & McClelland, 1990; Kanfer & Gaelick, 1986; Logan & Cowan, 1984; Norman & Shallice, 1985; Posner & Rothbart, 2000; Thayer & Lane, 2000). Despite important differences in the regulation of emotion, cognition, and behavior, selective attention represents a common regulatory mechanism for each of these domains. Thus, though often categorized as a cognitive variable, we view attention as a "top–down" self-regulatory mechanism capable of enhancing appropriate cognitions, emotions, or behaviors, and suppressing inappropriate cognitions, emotions, or behaviors. Such a mechanism is consistent with recent neural network models and neuroscientific approaches that emphasize selective attention and cognitive control (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001; Cohen et al., 1990; Desimone & Duncan, 1995).

In neural network models, particular cognitions, emotions, and behaviors can be represented as networks of coactivated neurons. These networks are activated automatically in a "bottom–up" manner as responses to particular stimuli. According to this perspective, the most activated network of neurons represents the most dominant or prepotent cognition, emotion, or behavior. These are the most likely responses in a given situation. However, alternative responses also are available in the form of less activated neural networks. These responses can become dominant if their activation levels are enhanced by top–down, selective attention. Thus, according to this perspective, the regulation of a dominant response requires the use of limited-capacity, selective attention to enhance the activation level of a nondominant, but more adaptive, response.

The neural network language fits well into language previously used by the RMH (Patterson & Newman, 1993), according to which failures in self-regulation can occur when individuals fail to shift attention to nondominant cues that suggest an important modification of an individual's current dominant response set. We use the phrase "dominant response set" or "dominant response" to refer to the most dominant networks activated at a given time, whereas the term "response" is used generally to refer not only to behavioral responses but also to cognitive and emotional responses. We refer to dominant or nondominant "cues" to indicate that certain stimuli are associated with, or activate, a dominant or nondominant network. Finally, cues can be external stimuli (e.g., a phone ringing) or internal stimuli (e.g., one thought activates another, related thought). Thus, according to the current form of the RMH, if an individual fails to allocate attention to nondominant cues, the responses associated with these cues will fail to achieve a level of activation necessary to compete successfully with a dominant network. Thus, the dominant response set remains unmodified by nondominant cues. This will lead to dysregulation if these nondominant cues are associated with a more adaptive response than the dominant response set.

A classic example of a failure to modify a dominant response is provided by Hamilton, who reports that "Archimedes . . . was so absorbed in geometrical meditation that he was first made aware of the storming of Syracuse by his own death-wound" (as cited by James, 1890, p. 419). In the language of RMH, Archimedes allocated so much attention to his dominant set (thoughts of geometry, geometrical figures on the page, etc.) that he failed to allocate sufficient attention to nondominant cues (e.g., the sound of a battle) that could have saved his life.

The allocation of attention is central to self-regulation in our framework. If too much capacity is allocated to dominant cues, individuals may fail to moderate their dominant behavior by accommodating important information suggested by nondominant cues (e.g., Archimedes). This is the classic case emphasized by the RMH. On the other hand, if too little capacity is allocated to dominant cues, nondominant cues can become dominant and hijack behavior. In such a case, individuals may be distracted from engaging in their most adaptive response, because attention is hijacked by a less adaptive response. The addition of this second case extends and generalizes the RMH by emphasizing the need for context-appropriate attention allocation to dominant and nondominant cues.

The appropriate balance of allocation to dominant and nondominant cues depends on the particular context. For example, if students need to concentrate on studying for a geometry exam, it is adaptive to focus more attention on studying (their dominant response) and less attention on distracting, nondominant cues. In this case, dysregulation might occur if the students fail to maintain enough attention to their studies and become distracted by irrelevant cues. On the other hand, undivided attention to study was not appropriate for Archimedes, who successfully allocated attention to accomplish his goal (e.g., understanding a geometric principle) but failed to accommodate cues that should have suggested a more context-appropriate goal (e.g., saving his own life). Thus, dysregulation can occur when attention is allocated inappropriately for a given context. In the first case, nondominant cues can disrupt an important goal and lead to dysregulated behavior. In the second case, nondominant cues fail to disrupt an important goal and lead to dysregulation. In either case, understanding how attention is allocated is critical to self-regulation.

How Is Attention Allocated?

It is seductive to say that "I" allocate attention to an important goal or a salient cue. The language conveys the idea of a free agent choosing where attention should be placed. However, this explanation is homuncular: How do "I" allocate attention? Also tempting is to propose that attention is allocated according to a current goal: "I adopt a particular goal and then allocate my attention to cues that will help me meet this goal." This is satisfying, because one can define effective self-regulation as anything that furthers one's goal, and dysregulation as anything that disrupts it. However, this answer also invokes a hidden homunculus: Who is adopting the goal? Furthermore, relying on goals in this manner leaves outside the discussion the case in which an individual successfully meets the wrong goal, as in Archimedes' case. In our view, this is important territory to include in a discussion of self-regulation.

Answering the question about how attention is allocated in a nonhomuncular manner is a daunting task, but one that seems tractable if we use the logic of neural networks (see Botvinick, Braver, Carter, Barch, & Cohen, 1998; Botvinick, Nystrom, Fissell, Carter, & Cohen, 1999; Botvinick et al., 2001). Indeed, one primary reason for the attractiveness of neural network models is the promise they hold for a nonhomuncular understanding of human behavior. The answer we present is not complete, but it does push us toward a nonhomuncular understanding of this critical question.

To answer the question, we first propose a tentative, nonhomuncular principle of attention allocation and present evidence for its plausibility. We suggest that selective attention is attracted to the currently most activated network and will activate nondominant networks as capacity allows. Thus, less activated networks will be processed only if capacity is available after processing more activated networks. Recent research on inattentional blindness suggests that this perspective is plausible. In a series of studies, Lavie (1995) manipulated perceptual load and found that as load on the primary task increased, attention to irrelevant distractors decreased. In the language of the CABA framework, when more capacity is allocated to dominant cues, less capacity is allocated to nondominant cues. Thus, as load is increased, attention to nondominant cues decreases.[1]

Finally, there is evidence that even highly salient emotional stimuli are not processed if attentional capacity is not available. Pessoa, McKenna, Gutierrez, and Ungerleider (2002) presented to participants fearful, happy, or neutral faces in the center of a computer screen, with bars in the left and right corners of the screen. After 200 msec, the bars were masked and the face was replaced with an "r", indicating that participants should respond. In the low attentional load condition, participants were instructed to attend to the face and indicate its gender. In the high attentional load condition, participants were instructed to attend to the bars and indicate whether bars were of similar (e.g., both horizontal) or different orientations. The activations of a variety of brain areas were measured with the use of fMRI. The results showed that all brain regions that indicated more activation to emotional faces than to neutral faces demonstrated this differential activation in the low load condition only. In the high load condition, each of these brain areas failed to show differential activation levels to emotional versus neutral faces. This suggests that the emotionality of the faces was not processed when top–down attentional resources were allocated to a demanding task. In CABA terms, the dominant cue in the low load condition was the face, whereas in the high load condition, the dominant cues were the bars. Thus, similar to the logic outlined by Lavie (1995), in the high load condition, the nondominant cues (i.e., the faces) were not processed when the dominant cues (i.e., the bars) required full processing capacity.

Given the importance of dominance within the CABA framework, it is worth noting again that dominance is viewed on a continuum; that is, we believe that a cue's relevance to a dominant response set is continuous rather than dichotomous. This is consistent with feature-based models of attention (e.g., Most et al., 2001), in which a dominant response set consists of attended dimensions or features (spatial location, luminance, shape, etc.). A cue will be very related to the dominant set if it shares all relevant dimensions, and it will be dissimilar to the degree that its characteristics do not overlap with all the relevant attributes specified by the dominant set. A series of experiments conducted by Most and colleagues (2001) provides evidence that this is the case. In Experiment 1, participants were asked to focus on the number of times L's and T's bounced off the edge of a computer screen. Half the participants were told to focus on white L's and T's, and the other half were told to focus on black L's and T's. On a critical trial, a cross took 5 sec to move horizontally across the screen, past the fixation point, and off the left side of the screen. The number of participants who noticed this unexpected stimulus was a dependent measure. Critically, the luminance of the unexpected cross varied across subjects from white to light-gray to dark-gray to black. Thus, the similarity of the cross to a participant's dominant set was manipulated. For example, for participants focusing on black L's and T's, a black cross overlapped on the luminance dimension with this dominant response set. Results demonstrated that the more overlap present between the cross and the participant's dominant set, the more likely the participant was to notice the presence of this unexpected stimulus. In a separate experiment, Most, Simons, Scholl, and Chabris (2000) found that when an unexpected cue (which did not overlap with any participant's dominant set) was presented in the same spatial location as targets, less than half the participants noticed its presence, if they were required to allocate attention to counting targets. However, when attentional capacity was available (participants were not required to count), every participant noticed the unexpected cue. These data are consistent with the idea that nondominant cues differ from dominant cues on a continuum, and that attention will be attracted to such cues to the extent that attentional capacity is available.

Taken together, these studies suggest that an individual's dominant set impacts what nondominant cues will receive attention. Furthermore, if more capacity is dedicated to dominant cues, there appears to be less attention available to attend to nondominant cues. This may be true even when nondominant cues are well-learned, and this apparently extends to emotional cues as well. Thus, when substantial capacity is required for the processing of a dominant set, an individual may lack the capacity to attend to nondominant cues. However, the flip side of this coin is that attention can be hijacked by a nondominant cue, if capacity is available.

Another way that attention can be allocated to a nondominant network is if a dominant and nondominant network compete. If two (or more) networks suggesting incompatible responses achieve about the same level of activation, this conflict must be resolved by top–down attention. Otherwise, there is no clear response available. In the language of the RMH, if a nondominant cue indicates a problem with the current dominant response set, this conflict emits a "call for processing." This call must be answered by top–down attention for effective self-regulation to occur. For example, in an incongruent trial of a classic Stroop task (Stroop, 1935), individuals must choose between a word-related and a color-related response. If the word "red" appears in blue ink, for instance, one response network indicates "red" as an answer, whereas the other indicates "blue" as the answer (see Cohen & Huston, 1992). Top–down attention can resolve this conflict by activating the appropriate response.

Another important type of conflict is the conflict between expected or goal-consistent cues and unexpected cues, between expectations and reality. As with a response conflict, this type of conflict emits a call for processing that must be answered by top–down attention. In this case, attention is necessary to process the incongruent cue, to determine whether it represents valuable information that indicates current behavior must be changed or modified.

Does Our Definition Capture Self-Regulation?

Before describing specific applications of the CABA framework, we consider whether the current definition of "self-regulation" captures what is normally meant by self-regulation. In an overview of self-regulation failure, Baumeister and Heatherton (1996) specify three main ingredients of self-regulation, as suggested by feedback-loop models of self-regulation (e.g., Carver & Scheier, 1998): (1) standards and goals, (2) monitoring, and (3) correction. In this scheme, a failure in self-regulation can occur because of a lack of standards or goals, standards or goals that are too high or too low, or the presence of incompatible/conflicting standards or goals. Dysregulation also can occur as a result of a failure to monitor existing states, thereby failing to register a discrepancy between an individual's standards and actual state. Finally, it is possible that an individual has appropriate goals, is aware that current responses need to be corrected, but lacks the ability to do so.

The CABA framework captures each of these possibilities. From our point of view, standards or goals are conceived as networks (see MacCoon & Newman, in press). Though neither a goal nor a standard need be conscious, both could be established by directing top–down attention to a network or group of networks that, together, represent a current goal or standard. The lack of a goal would be represented as the lack of a coherent set of networks suggesting a clear response to a particular situation. If a network representing the actual state of affairs conflicts with a dominant response, or current goals and expectations, this discrepancy would represent a call for processing. Answering this call for processing will depend on the allocation of attentional capacity. Consistent with the literature reviewed on inattentional blindness, an individual may not recognize the existence of conflicting nondominant cues without available capacity. Correcting a maladaptive response depends on whether enough capacity is available to activate a nondominant network above the current dominant network. Thus, the reasons for dysregulation suggested by Baumeister and Heatherton (1996) can be translated into the neural network terms used by the CABA framework. Furthermore, the current emphasis on the limited capacity of top–down attention, and the important role it plays in self-regulation, is consistent with Baumeister and Heatherton's similar emphasis.

Neurobiological Plausibility

Using a neural network approach to the RMH allows our model of self-regulation to dovetail with modern cognitive neuroscience. At a minimum, we believe that the mechanisms proposed by a self-regulatory perspective should be biologically plausible. Accordingly, we briefly discuss the neurobiological plausibility of our framework. At a general level, neural network approaches highlight the important interaction of "top–down" cognitive control and "bottom–up" automatic influences (e.g., Cohen & Huston, 1992; Cohen et al., 1990; Desimone & Duncan, 1995). Top–down control corresponds to our use of selective attention, whereas sensitivities or biases correspond to bottom–up influences. Cognitive neuroscience is attempting to map top–down control and bottom–up biases to specific neural circuitry. For example, the prefrontal cortex (PFC) has been associated with top–down control (e.g., Cohen et al., 2000) and the maintenance of a current attentional set in the face of distractors (Miller & Cohen, 2001). In our language, the activation of dominant cues is likely to be maintained, in part, by the neurons in the PFC. How information is "gated in" to the PFC is a critical issue that may be illuminated by neuroscientific advances. For example, phasic activity of the locus coeruleus–norepinephrine (LC-NA) system has been associated with increased signal-to-noise ratios and coincides with attentional orienting and superior selective attention (Aston-Jones, Rajkowski, & Cohen, 1999; Usher, Cohen, Servan-Schreiber, Rajkowski, & Aston-Jones, 1999). Dopamine (DA) may also play a critical role in changes in cortical acetylcholine, which appear to mediate allocation of attentional resources (Sarter, Bruno, Turchi, & Nadasdy, 1999; Turchi & Sarter, 1997), and possibly mediate narrowed attention (Dunne & Hartley, 1985). Both systems provide potential neurobiological mechanisms for attentional allocation to dominant and nondominant cues.

The amygdala also is likely to play a role in attentional allocation. The amygdala is best known for its role in the acquisition and expression of fear (e.g., Armony & LeDoux, 2000). However, the amygdala also responds to reward cues (Gallagher, Graham, & Holland, 1990; Hatfield, Han, Conley, Gallagher, & Holland, 1996; Rolls, 2000; Roozendaal, Oldenburger, Strubbe, Koolhaus, & Bohus, 1990) and is involved in processing stimuli that signal a change in reinforcement (e.g., Hatfield et al., 1996). These and other data (e.g., Whalen, 1998) have led to a broader view of the amygdala as a structure that processes ambiguous stimuli that are important for current learning. Particular nuclei of the amygdala are thought to play specific roles in this processing, with the central nucleus in particular being well-suited to increase the allocation of top–down attention to the processing of contextual (in our words, nondominant) cues (Whalen, 1998; Whalen et al., 2001).

The functions of the anterior cingulate cortex (AC) are consistent with a call for processing that results from response conflict. Specifically, activation of the AC may be associated with evaluating response conflicts and indicating the need for top–down control (Carter et al., 2000). Consistent with this proposal, Carter and colleagues (2000) used fMRI to measure AC activation in response to different conditions of a Stroop task. When participants expected a high degree of conflict (in blocks with 80% incongruent and 20% congruent trials) and were thus likely to exert top–down control to minimize response conflict, the AC was relatively inactive on incongruent trials. However, when participants expected a low degree of conflict (in blocks with 20% incongruent and 80% congruent trials), and thus were unlikely to exert top–down control to minimize response conflict, the AC was relatively active on incongruent trials. In other words, the activation of the AC appears to correspond to those trials in which response conflict is high and top–down control is low, a pattern consistent with the view that the AC recognizes conflict and calls for the top–down control necessary to resolve it.

The functions of the hippocampus may be consistent with a call for processing emitted by a conflict between expected or goal-consistent cues and unexpected cues. The hippocampus, a structure that has been a focus for the RMH since the model's inception, responds differentially to cues and secondary goals that are not adequately represented in the current top–down set (Gray & McNaughton, 2000); that is, the hippocampus may boost the activation level of nondominant cues that may be important for moderating the dominant set. For example, rats with a lesioned hippocampus showed fear conditioning to a tone associated with shock but did not show fear conditioning to contextual cues (Kim & Fanselow, 1992), whereas rats with a lesioned amygdala showed no conditioning to the tone but did show conditioning to the context (see also Kim, Rison, & Fanselow, 1993; Phillips & LeDoux, 1992).

We have associated various brain regions (e.g., the PFC, amygdala, and hippocampus) and systems (e.g., the LC-NA and DA systems) with particular aspects of our framework. Bottom–up cues are not likely to be represented by any region in particular; instead, bottom–up processes are likely to be represented throughout the brain. For example, visual stimuli are represented in visual cortices, whereas auditory aspects of stimuli are represented in the auditory cortex. Further research will determine what cognitive concepts can be mapped onto particular brain circuitry, but the RMH view of self-regulation is well-poised both to inform this search and to benefit from its progress.

Summary

We have defined "self-regulation" as the context-appropriate allocation of attentional capacity to dominant and nondominant cues. We have described how a given cognition, emotion, or behavior can be represented as the most activated neural network at a particular moment, and have discussed how this dominant network may be moderated by the influence of other, nondominant networks through attentional allocation. If capacity is available, attention can increase the activation of nondominant networks, thereby increasing their moderating influence on the current dominant response. We have specified a continuous relationship between dominant and nondominant cues, suggesting that a cue is nondominant to the extent its features are dissimilar to features of the dominant set. Put another way, a cue is nondominant to the extent its features do not overlap with the features of the currently dominant cues. Finally, we have proposed that top–down attention is allocated automatically from the most to the least dominant cues, as capacity allows. If two networks achieve similar levels of activation, this conflict attracts attention and is resolved by top–down attention.

Together, these points suggest that regulation is necessary when there is a conflict that, if resolved correctly, will lead to a more adaptive response. Regulation is advisable when a nondominant network represents a more adaptive response. Regulation will fail if there is a context-inappropriate allocation of attention, a situation that can occur for a variety of reasons: (1) if an adaptive network does not achieve the level of bottom–up activation necessary to compete effectively with dominant networks; (2) if an adaptive network achieves enough activation to compete with a dominant response but the conflict is not registered; and (3) if a conflict is registered but there is no allocation of top–down resources to respond to the conflict.

THREE MECHANISMS

In the sections that follow, we use the CABA framework to describe three distinct mechanisms for a failure to allocate necessary top–down resources. First, we argue that psychopathic individuals have a deficit in automatically allocating top–down resources to nondominant cues. We discuss this mechanism in relation to psychopathy, because much of the research done with the RMH has been applied to psychopathic individuals, and much of the available laboratory data can be explained by a deficit in automatically allocating top–down attention. It is this research with psychopathic individuals that best supports the existence of this mechanism and its importance for self-regulation. The mechanism may be overlooked by many self-regulatory theorists, however, because it may be relatively specific to low-anxious, psychopathic individuals. In contrast, the second mechanism may represent a more widely applicable mechanism for self-regulatory problems. The mechanism involves individual emotional biases that prevent a context-appropriate allocation of top–down attention. We explore this mechanism in reference to a variety of psychopathologies and temperaments (e.g., extraversion and neuroticism). Finally, we review theoretical and empirical work suggesting that acute alcohol consumption leads to dysregulation by reducing the amount of capacity available to allocate.

Psychopathy: A Deficit in Automatically Allocating Top–Down Attention

Consider a scene inspired by the movie *Kalifornia* (Bigelow & Sena, 1993). On a rainy night, a bored young man named Early comes across a large rock. Seeing a bridge nearby and an approaching car, he casually decides to see what would happen if he dropped the rock on the car. Early watches as the rock he has dropped from the bridge lands on the windshield of the car, cracking it. He watches as the driver loses control, the car flips over, and both people in the car die. Thirty minutes later, Early enjoys his girlfriend's appreciation as she receives his gift to her, a pair of red pumps worn by the female passenger in the car.

Such a series of acts is a dramatic example of behavior that might be carried out by a psychopathic individual. It is also an example of behavior that some would call "evil," carried out by a "monster" with no regard for human life. We argue that the callous, antisocial behavior and impulsive violence characteristic of psychopathic individuals occur because such individuals fail to interrupt their current dominant set and shift their attention automatically to nondominant cues that suggest a more adaptive response (Wallace & Newman, in press; Wallace, Schmitt, Vitale, & Newman, 2000). We review laboratory evidence supporting this hypothesis, evidence that also argues against other possible mechanisms, such as low intelligence, inadequate motivation, increased sensitivity to reward, or decreased sensitivity to punishment (i.e., fearlessness; for more complete reviews, see Newman, 1998; Newman & Lorenz, 2003).

Our attentional hypothesis suggests that regulating a violent response requires that networks associated with a nonviolent response be activated enough to attract attention, and that attention is allocated to these networks. The RMH suggests that the latter mechanism is deficient in psychopaths. Thus, if a violent behavior becomes dominant, psychopaths are less likely than others to allocate capacity to process nondominant networks associated with a nonviolent response.

Passive avoidance tasks are ideal for testing this hypothesis. RMH predicts that psychopaths will show poor passive avoidance compared to controls. When a psychopath is focused on "go" behavior and cues suggesting inhibition of this behavior are nondominant, he or she will "go," whereas nonpsychopaths will inhibit this response.

In a classic passive avoidance experiment by Lykken (1957), individuals were required to navigate a mental maze by pressing one of four levers. At each point in the maze, pressing one of the incorrect levers resulted in electric shock. The dominant task was to learn to navigate the maze as quickly as possible. Because shock was incidental to learning the maze, our perspective suggests that the nondominant task was to avoid electric shock. Psychopaths and controls did not differ on the dominant task: Both learned to navigate the maze with equal speed. However, whereas controls showed decreasing numbers of shocks as they learned the maze, psychopaths committed the same number of punished errors throughout, apparently not trying to avoid the shocks at all. This experiment led to the hypothesis that psychopaths are insensitive to punishment (i.e., fearless).

This intuitively appealing hypothesis predicts that psychopaths will differ from controls when punishment cues are present, but will not differ from controls when reward or neutral cues are the only stimuli present in a task. However, this clear prediction has been proved false. We review studies demonstrating that psychopaths' deficit is more general (e.g., the two groups differ in experiments that use only neutral cues) and more specific (e.g., the two groups do not differ in when punishment cues are the only cues present in a task). Instead of supporting a fear deficit, this evidence supports the idea that psychopaths fail to attend to nondominant cues when their attention is engaged already in another, dominant task. Furthermore, because psychopathic and nonpsychopathic participants were well matched on intelligence in each of the studies we review, this does not present a likely explanation for group differences. Several of the studies also argue against the hypothesis that psychopaths are less motivated to perform well than controls.

Newman and Kosson (1986; see also Thornquist & Zuckerman, 1995) used a passive avoidance task to test whether psychopaths were insensitive to punishment, or whether their insensitivity was dependent on an attentional shift. In one condition, participants received money for correctly responding to "good" numbers and lost money for responding to "bad" numbers. Another condition was identical to the first except that the reward contingency was eliminated—only punishment or avoidance of punishment was possible. Because the first condition involves shifting attentional focus between reward and punishment and the second does not involve a shift of focus, the RMH predicts that psychopaths will fail to inhibit their "go" response in the reward–punishment condition but not in the punishment-only condition. In contrast, the low-fear hypothesis predicts passive avoidance deficits in both conditions. Consistent with the RMH, psychopaths showed poorer passive avoidance only when a shift of attention was required (in the reward–punishment condition). Note that because psychopaths' performance was comparable to that of controls in the punishment-only condition of the task, low motivation is not a plausible explanation for the results.

Thus, it appears that psychopaths are responsive to punishment cues when these are the only cues available. However, the RMH makes a more specific prediction: Psychopaths should attend to punishment cues even in a combined reward–punishment task if the task does not require automatic attentional shifts. Newman, Patterson, and Howland (1990) tested this prediction by using a passive avoidance task in which participants were forced to allocate top–down attention to both reward and punishment cues from the outset of the task. In this way, both types of cues were dominant, obviating the need to reallocate attention to nondominant cues during the execution of the task itself. Under these conditions, psychopaths and controls performed similarly.

Results from a gambling task (Newman, Patterson, & Kosson, 1987; Siegel, 1978) also support the attentional hypothesis. In the Newman and colleagues (1987) study, participants won money if a face card was dealt by the computer and lost money if a nonface card was dealt. Because face cards occurred frequently in early blocks and were gradually reduced as play continued, players started the task by winning frequently, gradually won less money as the task continued, and ultimately began losing money. Participants were told that they could stop playing at any time. This decision required modifying the dominant set of playing and winning by using information about the increasing probability of losing (a nondominant cue). Participants played the game in one of three conditions: The computer screen showed no record of cards played, showed a cumulative record of cards displayed on the top of the computer screen in 10-trial blocks, or showed a cumulative record and interrupted play for 5 sec after each trial. In the first condition, nondominant cues of changing probabilities were less salient than in the second condition. In the third condition, participants were forced to interrupt their dominant set, and they were provided with salient, nondominant cues. The authors predicted and found poor performance in psychopaths compared to controls in all but the last condition. Thus, only when their dominant response was interrupted were psychopaths able to allocate attention to nondominant cues, process the fact that contingencies were changing, and modify their card playing behavior as a result. In addition to supporting the RMH, this task makes it clear that psychopaths' deficit can result in harm to themselves, thus emphasizing the self-regulatory nature of their problem.

If it is true that attentional allocation, rather than reward or punishment sensitivities, accounts for psychopaths' dysregulated behavior, psychopaths should fail to attend to any nondominant cue, even when emotion is not involved at all. This is exactly what was found by Newman, Schmitt, and Voss (1997), who used a computer task with emotionally neutral dominant and nondominant cues. In this task, participants viewed pictures with words printed on them. If the dominant cue was a picture, a "P" preceded the trial, if the dominant cue was a word, a "W" preceded the trial. Participants performed better on the task when they were able to focus on the dominant cue and ignore the other, nondominant cue. In this case, psychopaths' deficits should help them perform well on the task, because they fail to shift attention to nondominant cues, whereas controls should do so automatically. Results were consistent with this prediction: The irrelevant, nondominant cue interfered less with the performance of psychopaths than with that of controls. Importantly, these results have been replicated (Hiatt, Schmitt, & Newman, in press).

Finally, it is important to note that the RMH *does* predict that psychopaths will have difficulty using emotion. In this way, the theory is consistent with other theories that emphasize emotion as a deficit in psychopathic individuals (e.g., Blair, 1995; Lykken, 1957, 1995). In keeping with the passive avoidance findings, the RMH predicts that psychopaths will show poor processing of emotion when emotional cues are nondominant and attention is focused on another, dominant cue. To test this prediction, Lorenz and Newman (2002) used a lexical decision task adapted from Williamson, Harpur, and Hare (1991), with positive, negative, and neutral words. Based on a constellation of findings, the authors suggested that psychopaths' failure to process emotion cues is better construed as a failure in response modulation.

The studies described are consistent with the idea that psychopaths fail to allocate attention to nondominant cues when their attention is already allocated to dominant cues. Whereas controls can use nondominant cues automatically, psychopaths appear to have difficulty doing so (see Newman, 1998). This deficit explains why psychopaths can look fearless, but it specifies the conditions under which this will be the case. It also successfully predicts situations in which psychopaths will not look fearless or appear insensitive to punishment cues. The deficit is also consistent with the idea that psychopaths can be emotionless, but, again, it specifies the particular conditions in which this is likely to be the case.

We have been interested in the boundary conditions of the psychopathic deficit. For example, what are the precise conditions under which a psychopath will be able to use a nondominant cue? What role does capacity play? The RMH proposes that psychopaths can allocate attention to cues that are highly related to the dominant response set or that have been made explicitly the object of attention as part of task instructions (in this sense, they become dominant cues). However, when nondominant cues minimally overlap with the dominant set, allocating attention to these cues may be more effortful in psychopaths than in controls and, thus, require more capacity. There is some evidence that psychopaths can make moment-to-moment shifts of attention between one set of cues and another, such as in a divided attention task, but will have to allocate more capacity than controls to the superordinate task of managing a "joint allocation policy" (Kosson & Newman, 1986). For example, Kosson and Newman (1986) used a visual search task and a go/no-go probe-reaction time task with psychopaths and controls in two conditions. In the focused attention condition, participants were told that the visual search task was their primary task, whereas in the divided attention condition, instructions emphasized that performance on both tasks was important. There were no baseline differences between psychopaths and controls, and both groups performed equally well in the focused attention condition, in which switching attention to the nondominant task was not required. However, in the divided attention condition, psychopaths performed more poorly than controls on the visual search task, indicating that they had less capacity available for the search. The authors concluded that the most likely explanation was that psychopaths required more capacity to manage the allocation of their attention between the two tasks; that is, psychopathic individuals must use more capacity to reallocate attention from their top–down set to nondominant cues. Put slightly differently, controls can rely on a more automatic allocation of attention than can psychopaths. Thus, the RMH hypothesis predicts that manipulations meant to reduce limited-capacity resources (e.g., memory load) would not result in performance differences between psychopathic individuals and controls, unless a psychopath is required to manage attention shifts effortfully (which takes capacity) and controls accomplish those shifts relatively automatically.

The CABA perspective makes unique predictions regarding psychopathic information processing. If cue overlap is important, as we have suggested, we would expect such overlap to have a significant effect on whether psychopathic individuals can process information automatically. Recent evidence presented by Hiatt and colleagues (in press) suggests that this is the case. In Experiment 1, which used a color–word Stroop task, psychopaths and controls showed similar interference, indicating similar processing of irrelevant word meaning. In Experiment 3, however, the Stroop task was modified so that the color and word did not overlap spatially. This was accomplished by having white-colored words appear in the center of a colored rectangle (e.g., the word "blue" appeared in the center of a red rectangle). In this way, participants could focus their attention on the spatially distinct colored rectangle, ignoring the irrelevant word displayed in the center of the rectangle. Controls, but not psychopaths, showed significant Stroop interference on this task, which suggests that psychopaths did not process incongruent words. However, psychopaths and controls showed comparable facilitation on trials in which the word and rectangle color matched (e.g., the word "blue" appeared in the center of a blue rectangle).

Although, for these trials, the cues obviously remain spatially separated, note that word meaning and color overlap semantically—they are the same color. Consistent with the current perspective, this suggests that psychopathic individuals do process information automatically when cues overlap, but they fail to do so when overlap is minimized.

In a different experiment (Newman, MacCoon, & Vaughn, 2003, Study 3), psychopaths and controls were compared in their processing of nondominant cues under conditions of low and high load. If psychopathic individuals have difficulty processing secondary information automatically, their failure to process secondary information should exist, regardless of load manipulations. Results were consistent with this perspective.

Several features of the scene from *Kalifornia* described earlier deserve mention. First, consistent with clinical descriptions of psychopathic individuals (e.g., Cleckley, 1976), Early's decision to throw the rock was poorly motivated. In *Kalifornia*, the narrator reminds us that many people have had fleeting thoughts of dropping a penny from the top of a high building. Most of us, however, also attend to a variety of other thoughts (e.g., "Someone will be hurt badly, perhaps a child"; "I might get in trouble for causing injury to someone"; "I can use the penny in the gumball machine instead"; etc.) that cause us to dismiss the idea. According to our account, Early does not shift his attention to nondominant cues such as these; therefore, he does not dismiss the idea. Without attention to these nondominant thoughts, a casual idea is converted into action. Second, Early shows little or no compassion for his victims. Instead of running away from the scene, or exhibiting horror or remorse at what he has done, Early steals a victim's shoes. According to our attentional hypothesis, Early simply focuses his attention on the shoes and does not shift his attention from this dominant cue to other cues associated with compassion, horror, remorse, or fear. Indeed, given a lifetime of nonshifting, it is unlikely that Early will have learned to associate emotional responses with his behavior. Finally, Early gives the stolen shoes to his girlfriend. This is noteworthy for three reasons. First, the fact that Early's girlfriend's birthday falls on that same evening emphasizes the fact that Early did not plan the gift ahead of time: His gift was a spontaneous convenience, much as the thought of throwing the rock was inspired by its coincidental presence. Second, this "evil" man is doing something nice for his girlfriend for her birthday. According to the RMH, the reason Early is doing something nice is much the same as the reason that he picked up a rock and killed two people: Seeing the shoes activated a network associated with his girlfriend's birthday. After Early's attention was focused on this goal, it became his new dominant response. Third, Early shows no apparent discomfort when giving the shoes to his girlfriend. It is as though Early has divorced himself completely from the act that led to his acquisition. Indeed, the ability to achieve such complete separation is consistent with a failure to shift attention to anything unrelated to the current dominant response.

Finally, whereas psychopathy, as diagnosed by the Psychopathy Checklist—Revised (Hare, 1991), includes criminal or antisocial behavior in several of its items, the attentional mechanism we propose should be present in persons without an antisocial background; that is, the form that dysregulated behavior takes should depend on the learning history of the individual: A person with an antisocial background is more likely to have a violent response become activated in a particular situation than is a person without such a background. Thus, a corporate executive with the same attentional deficit would exhibit dysregulated behavior consistent with his background. For example, he might be more likely to harass an employee sexually than to assault that employee. How would this work according to the current framework? Suppose a particular executive's dominant response upon seeing a beautiful woman is to make sexual advances toward her. He likes the challenge and has enjoyed a fair amount of success. When he sees a beautiful employee, his dominant response may be the same. However, because he is less likely than a nonpsychopathic executive to attend to nondominant networks (e.g., "Sexual advances are unethical"; "Sexual advances may ruin our working relationship"; "Sexual advances toward another woman would anger my wife," etc.), the psychopathic executive is more likely to harass his employee sexually. Thus, compared to an executive without the attentional deficit (but with the same background), he is more likely to exhibit a dysregulated dominant response.

Emotion-Driven Narrowed Attention

Whereas the psychopath's deficit is unrelated to the emotionality of a given situation, dysregulation in other forms of psychopathology is related to emotion. Newman and Wallace (1993) proposed three pathways to dysregulated behavior, all of which emphasize the importance of dominant and nondominant cues. The psychopath's deficit in shifting attention represents one pathway. The other two pathways emphasize the role of emotion in causing dysregulation. The principle is that individuals with a bias to a particular type of emotional cue will tend to focus more of their attentional capacity on that cue, thus having less capacity available to attend to nondominant cues that might otherwise moderate their behavior. Thus, like the psychopathic pathway, the emotion pathways emphasize the importance of attending to dominant and nondominant cues in a context-appropriate balance. Unlike that of a psychopath, the deficit specified for the emotion pathway is specific to a situation involving an individual's emotional bias.

Consider a person with an eating disorder. In one situation, a room is relatively free of cues related to weight or eating; in another situation, the room is the same except for the presence of a scale. In the first situation, this individual will be able to attend to networks representing multiple response options and choose the best—or most adaptive—response as a result. In the second situation, a network associated with the individual's concern over weight will become highly activated, and the individual will focus more of his or her attention on this network, leaving less capacity to activate (and thus consider) the other response options. Thus, the individual in this situation is less likely to choose the most adaptive response.

This hypothesis was tested in a study conducted by Newman and colleagues (1993, Study 3). Controls and participants from an eating disorders clinic were asked to respond to letter or number strings presented centrally (75% of the time) or peripherally (25% of the time) on a computer monitor. The high probability of centrally presented stimuli established a dominant attentional set. To signal the start of each trial, a word appeared centrally. The word was either related to body concerns (e.g., "scale"), an emotional word unrelated to body concerns (e.g., "sad"), or a neutral word (e.g., "pattern"). The authors predicted that participants from the eating disorders clinic would make slower letter–number decisions to peripheral strings than controls when words related to their bias were presented as a warning stimulus, because these words would attract attention and slow the processing of the nondominant peripheral cues. Results supported these predictions.

A similar study (Experiment 1) used a modified version of the task with non-clinically anxious and nonanxious participants. Warning words consisted of physical threat words (e.g., "injury"), social threat words (e.g., "ridiculed") or safety words (e.g., "friend"). Anxious individuals were slower to respond to targets when the central word was related to their bias (i.e., a threatening word), a result consistent with the idea that when individuals are presented with a cue related to their bias, attention focuses on this cue and reduces the processing of nondominant cues.

Given the importance of self-discrepancies in the initiation of self-regulation (e.g., Carver, 1979; Carver & Scheier, 1998; Higgins, 1987), the authors tested whether warning words related to a self-discrepancy also would reveal a similar pattern (Newman et al., 1993, Experiment 2). Self-discrepancy theory (Higgins, 1987) proposes that individuals are motivated to reduce any discrepancy between their actual self (qualities that the individual believes she or he possesses) and their ought self (qualities that the individual or significant others believe she or he should possess). Controls were individuals who had low discrepancies of any kind, and the experimental group had high actual–ought discrepancies. Participants were given words that were either relevant or irrelevant to their discrepancies. Results were consistent with prediction. When members of the high-discrepancy experimental group were presented with words related to their discrepancies in the center of the computer screen, they responded more slowly to peripheral cues relative to trials in which irrelevant words were presented centrally. These and the other results reviewed are consistent with the idea that emotionally relevant cues can disrupt the processing of nondominant cues and cause poorer performance on a laboratory task in anxious individuals, individuals with eating disorders, or nonpathological individuals presented with self-discrepant cues.

These three studies suggest the generalizability of emotion-mediated narrowing of attention and suggest its applicability to self-regulation. The framework also has been used to understand the role of neuroticism in dysregulation. Neuroticism, an important variable in self-regulation, is associated with negative affect (e.g., Costa & McCrae, 1980; Eaves, Eysenck, & Martin, 1989; Larsen & Ketelaar, 1989; Tellegen, 1985; Watson & Clark, 1984) and various forms of psychopathology, including anxiety (Gray, 1981; Wallace, Bachorowski, & Newman, 1991), depression (Enns & Cox, 1997; Scott, Williams, Brittleband, & Ferrier, 1995), alcoholism (Sher & Trull, 1994), and personality disorders (Widiger & Costa, 1994). Based on past work from our laboratory (Wallace & Newman, 1997; Wallace et al., 1991), we view extraversion as a bias to allocate attention preferentially to reward cues, and introversion as a bias to allocate attention preferentially to punishment cues. Neuroticism is associated with overallocating attention to an individual's particular bias (i.e., cues with high degrees of bottom–up activation). Thus, we typically investigate the effect of neuroticism on self-regulation by testing the effects of reward on extraverts, and the effects of punishment on introverts. We often compare stable (i.e., non-neurotic) extraverts to neurotic introverts, for example, because we expect the largest differences between these groups. This is because neurotic introverts have a punishment bias that is likely to be magnified by their neuroticism, whereas stable extraverts do not have such a bias and are not neurotic. Use of this approach has yielded results consistent with the proposal that neuroticism leads to dysregulation by increasing the allocation of attention to dominant cues.

For example, Wallace and Newman (1990) asked participants to trace a circle as slowly as possible, a task that requires the regulation of motor responses and has been used as a measure of executive function (e.g., Giancola & Parker, 2001). Wallace and Newman predicted that failures in self-regulation would occur if participants were required to perform the task in the presence of bias-related cues. According to the current perspective, bias-related cues can lead to dysregulated circle tracing as a result of several processing stages. First, such cues will activate networks incompatible with slow circle tracing. Second, these networks will attract more attention by virtue of their greater levels of activation, leaving less capacity available to regulate a motor response in accordance with task demands. Third, bias-related cues should increase nonspecific arousal in participants, especially in neurotic individuals. This increased arousal will increase the attention allocated to bias-related cues, further decreasing the capacity available to regulate motor responses. This perspective predicts that, in the presence of reward cues, neurotic extraverts will trace faster than controls (stable introverts), and that in the presence of punishment cues, neurotic introverts will show dysregulated (in this case, faster) motor responses. Results were consistent with these predictions and have been replicated (e.g., Bachorowski & Newman, 1990; Nichols & Newman, 1986), indicating a failure to regulate responses. These variables also have been applied to passive avoidance deficits, considered fundamental to maladaptive impulsivity (e.g., Patterson, Kosson, & Newman, 1987, Segarra, Molto, & Torrubia, 2000).

Newman, Schmitt, and colleagues (1997) conducted a two-phase study that provides better evidence for the current perspective. In the first phase, participants were told to press a button when letter strings appeared on the computer screen, unless the string contained the letter "Q." In this case, responses were punished. Thus, in phase 1, participants were trained to have an attention bias to a previously neutral stimulus. In phase 2, participants were told to respond to strings on the computer screen, unless they contained a number. Though the letter "Q" is irrelevant for phase 2, it should moderate responses to the degree it was attended to and processed as a punishment cue in phase 1. Thus, according to the current framework, an introvert with a preexisting bias to attend to punishment cues would be more likely to allocate capacity to processing the "Q." This tendency would be magnified in a neurotic introvert, because increased arousal should increase the amount of capacity allocated to punishment cues. Results were consistent with this perspective. Compared to stable extraverts, neurotic introverts responded more slowly to "Q"-present trials relative to "Q"-absent trials in phase 2, indicating that the bias acquired in phase 1 was difficult to regulate in phase 2. The performance of high- and low-anxious participants as defined by the State–Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, & Vagg, 1977) mirrored that of the neurotic introverts and stable extraverts, respectively. In this task, it is most adaptive to attend to the "Q" in phase 1, but allocate no special attention to it in phase 2. As predicted, however, anxious individuals who have a bias to process punishment cues have difficulty allocating their attention appropriately when the context changes in phase 2. As a result, they are more likely than controls to attend to an irrelevant stimulus, and their response times suffer.

The CABA framework's emphasis on the role of capacity in self-regulation makes unique predictions about information processing. For example, the framework predicts that as capacity decreases, individuals will continue to process bias-related cues (their priority) at the expense of processing cues unrelated to this bias. According to this perspective, anxious individuals should process neutral and bias-related (e.g., threatening or novel cues) cues alike, when capacity is available, but should process threat cues differentially as capacity decreases.

To illustrate the applicability of this situation to a nonlaboratory situation, imagine an anxious person, who is afraid of public speaking, standing in front of a large audience. Her task is to deliver her speech fluently, something she has done in practice when her attention was allocated completely to the task. However, in a room full of people, her bias is to attend to negative (or potentially negative) cues. Her speech will proceed smoothly to the extent that she can maintain her attention on her primary task without overallocating capacity to negative cues. At the beginning of the speech, networks associated with fluent speaking may be dominant. However, a bias toward negative cues means that such cues easily activate other networks that might include increased heart rate, sweating, and the urge to escape the situation. If cues associated with this network begin to capture attentional capacity, the activation level of these negative networks—and thus, their influence on behavior—will increase. Furthermore, as capacity is allocated increasingly to these negative networks, less capacity exists to activate a network consistent with a fluent delivery of the speech. As the allocation of attention changes, the likelihood that the anxious presenter will make an error increases. Unfortunately, a stutter, a long pause, or a mispronounced word are likely to increase the activation of negative networks and the amount of attention allocated to such networks, thus deepening the dysregulatory cycle.

In summary, emotional bias can cause a context-inappropriate allocation of attention by increasing an individual's allocation of attention to bias-related cues. This may negatively impact self-regulation either because affected individuals fail to attend to nondominant cues that might suggest a more adaptive response, or because bias-related cues distract individuals from the appropriate focus. We have presented evidence consistent with this type of mechanism in individuals with eating disorders, anxious individuals, individuals presented with self-discrepancies, and neurotic individuals with either reward- or punishment-related biases.

Alcohol-Induced Narrowed Attention

Giancola (2000) documents the positive relationship between acute alcohol consumption and impulsive aggression, and reviews several theories advanced to account for this relationship, including his own executive functioning framework. As Giancola's discussion makes clear, many theories emphasize concepts related to the dominant–nondominant dimension we are highlighting. Furthermore, these theories emphasize the role that alcohol plays in narrowing attention to dominant cues, the same mechanism advocated in the current framework. Pernanen (1976) proposed that alcohol reduces the ability to attend to and process environmental or internal cues that would moderate an aggressive response. Taylor and Leonard (1983) also proposed that alcohol reduces the number of cues to which an individual can attend: As the number of attended cues decreases, the likelihood of attending to inhibitory cues also decreases, thus making aggression more likely. Steele and Josephs (1990) proposed that alcohol impairs an individual's ability to allocate attention to nonsalient cues. As a result, processing and behavior are dominated by the most salient cues in the current context. If these dominant cues suggest an aggressive response and less dominant cues suggest an inhibitory response, aggression is made more likely.

Giancola's own framework (2000) emphasizes four skills that can inhibit impulsive aggression, each of which involves attending to and processing nondominant cues: (1) attending to and appraising situational information; (2) taking the perspective of others; (3) considering the consequences of one's actions; and (4) defusing a hostile situation. The first skill requires attending to multiple aspects of the environment; the second requires shifting attention from cues of personal relevance to cues representing another person's perspective; the third involves attending to nondominant cues that may suggest the inhibition of aggression; and the fourth requires scanning the environment to plan, monitor, and modify attempts to reduce hostility in an opponent. In short, inhibiting impulsive aggression may require the consideration of an alternative response. Finally, in integrating empirical work on alcohol's effects on emotion, Lang, Patrick, and Stritzke (1999) argue that alcohol affects emotion by disrupting higher brain functions, such as selective attention, that modulate affective brain systems.

The elements highlighted in each theory are consistent with our view of self-regulation. Specifically, they suggest that alcohol increases dysregulation by limiting the processing of nondominant cues through a reduction in top–down capacity. This perspective has been supported by recent studies that have used fear-potentiated startle. For example, in a study by Curtin, Lang, Patrick, and Stritzke (1998), participants who were served alcoholic or nonalcoholic drinks viewed gray backgrounds (low load) or pleasant slides (high load) either under threat of shock or in a safety condition. The authors found robust fear-potentiated startle in the threatening versus safe condition regardless of load in the nonalcohol group. Intoxicated participants also showed fear-potentiated startle in the low-load condition; however, when concurrent processing was required (i.e., high load), intoxicated participants did not show significant fear-potentiated startle.

These findings were replicated conceptually and extended by Curtin, Patrick, Lang, Cacioppo, and Birbaumer (2001) in a study that measured fear-potentiated startle, P3 event-related potentials, and response inhibition. In this paradigm, participants viewed animal or body part words on a computer screen. Shock was predicted by words of a particular category (e.g., animals), and the trial ended with the presentation of a blue square. In the low-load condition, participants simply viewed the words and were thus free to focus their attention on the threatening aspect of the word. In the divided attention condition, participants were required to hit a button when the blue square appeared, if the word had been presented in the color green, and to inhibit this response, if the word had been colored red. Thus, in this condition, participants were required to divide their attention between task instructions and the threatening aspect of the word. As predicted, when attentional capacity was divided, intoxicated participants showed reduced processing of threat (as indexed by reduced P3 differentiation between threat and safe words), reduced fear-potentiated startle, and reduced response inhibition.

Impulsive aggression is one form of dysregulation increased by alcohol. However, the emphasis on dominant and nondominant cues suggests that alcohol-related aggression is part of a more general self-regulatory problem: By reducing the amount of attention to nondominant cues, alcohol increases the likelihood that behavior will reflect only the dominant cues in a given context. Thus, if the dominant cues suggest an aggressive response, aggression is more likely. However, if the dominant cues suggest a nonaggressive response, nonaggression is more likely.

In a recent study, Casbon, Curtin, Lang, and Patrick (2003) manipulated memory load and dominant responses in alcohol-intoxicated or nonintoxicated students (for a review of alcohol, self-awareness, and self-regulation failure, see Hull & Sloane, Chapter 24, this volume). The experiment used an *n*-back task, in which letters are presented successively on the screen, and participants respond by pressing a button if the current letter matches the letter presented one screen before (the low-load, 1-back condition) or two screens before (the high-load, 2-back condition). The memory load condition was manipulated within-subject across blocks. In addition, the frequency of responding was manipulated by instructing participants to respond to targets on some blocks and respond to nontargets on others (targets were present on 20% of trials). The authors predicted that relative to nonintoxicated controls, intoxicated participants would fail to use changing contingencies to moderate their dominant response in the high-load condition. Consistent with this prediction, intoxicated participants in the high-load condition committed errors specific to the response made most dominant by the task: In 20% response blocks, these participants committed more omission errors than did controls; in 80% response blocks, they committed more errors of commission than did controls. Groups did not differ in the low-load condition or in overall task performance. These data suggest that when capacity is limited by the use of alcohol and then taxed by a demanding task, individuals are unable to use attentional capacity to modify their dominant response.

SUMMARY

We have defined self-regulation as the context-appropriate allocation of attention to dominant and nondominant cues. We suggest that for any given context, there is an ideal balance in the allocation of top–down attention, such that an individual's goals are met but can be flexibly modified by new information. We identified neural circuitry that might underlie the mechanisms we hypothesize. We have discussed how the allocation of attention to dominant and nondominant cues provides a useful perspective for understanding the callous and violent behavior that characterizes incarcerated psychopaths. Specifically, we have argued that psychopathic individuals fail to allocate their attention automatically from dominant to nondominant networks. We also have discussed one way that emotional biases can hijack top–down attention, thus disrupting context-appropriate allocation of attention. We have illustrated this point by highlighting neuroticism and extraversion as individual difference variables that play a prominent role in impulsivity and anxiety. Finally, we have reviewed theoretical and empirical work suggesting that alcohol acts as yet another way in which attention to nondominant cues can be reduced. As we have seen, the narrowed attention that accompanies acute alcohol consumption can lead to impulsive aggression and other dysregulated responses. Thus, it appears that, across several domains, self-regulation can be conceptualized as the context-appropriate allocation of attention to dominant and nondominant cues. In addition to offering a broadly applicable conceptualization of self-regulation, the CABA framework also suggests specific self-regulatory mechanisms that can be tested empirically. Finally, the perspective suggests particular individual-difference variables that can be used to understand these mechanisms and the consequences of poor self-regulation.

NOTE

1. If conscious awareness of stimuli depends on the activation level of a particular network, top–down attention focused on a network will increase awareness of that network. In a recent functional magnetic resonance imaging (fMRI) study, Rees, Frith, and Driver (1999) found that when attention was occupied with pictures, brain activation indicated no distinction between words and random letter strings, even when these stimuli were viewed directly. The authors concluded that "visual recognition wholly depends on attention even for highly familiar and meaningful stimuli at the center of gaze" (p. 2504); that is, when an individual's dominant set included only pictures, fMRI indicated no processing of nondominant words and letter strings. Similarly, in a study using event-related brain potentials, Bentin, Kutas, and Hillyard (1995) concluded that both attended and unattended words in a dichotic listening task activated semantic representations, but that attended words were more likely than unattended words to achieve the activation level necessary for conscious accessibility.

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