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Aberrant response inhibition and task switching in psychopathic individuals

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ABSTRACT

Deficits in cognitive control have been considered a core dysfunction of psychopathy, responsible for disrupted self-control. We investigated cognitive control impairments, including difficulties with task switching, failure of response inhibition, and inability to adjust speed of responding. Participants included 16 subjects with psychopathic traits (Ps), and 22 healthy controls (HCs). We recorded behavioral responses during a Task Switching paradigm, a probe of flexible behavioral adaptation to changing contexts; and a Go/NoGo Task, which assesses response inhibition and indexes behavioral impulsivity. During task switching, Ps evidenced impairments shifting set when conflicting (incongruent) information was presented, but performed as well as HCs in the absence of such conflict. In addition, when they encountered these difficulties, they failed to adjust their speed of responding. Ps presented also with deficits in response inhibition, with many commission errors on the Go/NoGo Task. This study identified impairments in response inhibition and in set shifting in psychopathic individuals. When shifting set, they evidenced difficulties refocusing on a new task when it was incongruent with the previous task. These deficits interfere with regulation of ongoing behavior and disrupt self-regulation. Our findings suggest abnormal neural processing during suppression of inappropriate responses in psychopathic individuals.

1. Introduction

Cleckley (1976) found that individuals with psychopathy have a reduced capacity to learn from experience. This may be due to underlying deficits in cognitive control in psychopaths (Hiatt and Newman, 2006). Cognitive control refers to the processes that allow people to modify their behaviors in a dynamic fashion on the basis of advance information and feedback derived from monitoring ongoing behavior (Carter et al., 1999). Self-control, which is essential for adaptive functioning 1890 (James, 1890), is strongly linked to cognitive control (Van Veen and Carter, 2006; Robinson et al., 2010).

Personality research on self-regulation has greatly benefitted from the application of concepts and experimental paradigms from cognitive control research, including response inhibition and task switching (Hofmann et al., 2012). Response inhibition entails an ability to select goal-relevant stimuli despite a habitual tendency to respond to other stimuli. This is often assessed through a Go/NoGo Task which requires inhibiting an automatic or learned habit response in accordance with task instructions. Commission errors on this task are considered inhibition failures. Poor response inhibition, as measured by Go/NoGo commission errors, has been reported in psychopaths (Lapierre et al., 1995; Roussy and Toupin, 2000).

In addition to response inhibition, effective cognitive control requires flexible behavioral adaptation to changing contexts, including set shifting, also termed task-switching, which refers to the ability to shift back and forth between different tasks and is considered one of the core functions of executive processes. This entails a "delicate calibration of endogenous control that is sufficient to protect an ongoing task from disruption, but does not compromise the flexibility that allows the rapid execution of other tasks when appropriate" (Monsell, 2003, p.134).

The task switching task is more difficult when the switch conflicts with the preceding set of responses, i.e., incongruent

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trials. Such trials demand allocation of additional cognitive resources for the suppression of the previously correct response (i.e., their incongruence). The literature reports more pronounced deficits in cognitive processing with greater cognitive load in psychopathy (Sadeh and Verona, 2012)

The cognitive ability evidenced on incongruent trials may also be related to response modulation which entails 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 and Newman, 1993, p. 717). Impaired response modulation was proposed as the core impairment in psychopathy in an influential model put forward by Patterson and Newman (1993). Psychopaths are unable to utilize information that is peripheral to their attentional focus and have difficulties switching to an alternative mode of responding. They also show difficulties shifting attention in dual-task situations. Suchy and Kosson (2006) found that psychopathic offenders made more errors on a verbal task which entailed forming and switching mental sets on trials with high executive demand. Such impairments are considered to be at the root of other deficits associated with psychopathy, as they prevent psychopathic individuals from arresting maladaptive behavior patterns (Newman, 1998).

Cognitive control also involves the ability to modify one's speed of responding, People normally adjust their speed when the task becomes more difficult in order to achieve better control and increased accuracy. Psychopaths may have difficulties with such adjustment (Newman, 1998).

This study investigates cognitive control deficits associated with psychopathy, through response inhibition and task switching paradigms. On some trials of Task switching (TS) paradigms subjects must repeatedly perform each task, while on other trials, they must switch over to another task. The task includes a "bivalent" stimulus display where the stimulus which prompted responses on one task is shown together with the stimulus for the alternate task. What was a peripheral stimulus on the first task becomes central on the alternative task. Thus, in addition to comparing switch and repeat trials, one can also compare responses to congruent versus incongruent trials. As such, this task can further assess the response modulation deficit associated with psychopathy.

We were also interested to see how affective cues modulate cognitive control, as they are known to affect cognitive performance (Davidson, 2002). Normally cognitive performance is impaired when negative emotions are aroused. This has been explained on the basis of "resource allocation", i.e., emotional states consume resources which are no longer available for cognitive control (Ellis and Ashbrook, 2005). In psychopathy, however, this may not be the case. Impaired emotional responsiveness is considered to be a hallmark of psychopathy. Psychopathic individuals have a diminished capacity for emotional responding (Blair and Mitchell, 2009). As a result of this, emotions may have a lesser impact on cognitive processes in psychopaths than healthy controls. Psychopaths may not suffer from such emotional drainage because of their limited emotional reactivity. In one study (Mueller, 2007), for example, healthy controls, but not psychopaths, made more errors when negative stimuli were presented, suggesting that the impact of emotional stimuli on cognitive control is weaker in psychopaths. Christianson et al. (1996) examined the extent to which emotional, relative to neutral, content in images interfered with the recollection of non-emotional peripheral content. The control group showed reduced recall of the peripheral content for emotional slides whereas the psychopaths did not. In line with this, we predicted that negative emotional valence would play a lesser role for psychopaths than healthy controls on the response inhibition task.

In summary, the goals of this study were: (a) to define impairments in cognitive control associated with psychopathic traits, including response inhibition, response modulation, and ability to modify speed of responding, and (b) to investigate the influence of affect on cognitive control.

2. Methods

2.1. Subjects

Sixteen subjects with psychopathic traits (Ps) and 22 healthy controls (HCs) participated in the study. All participants (aged 18–55 years) had no significant medical/neurological illnesses and no major psychiatric illness. The Ps were subjects who were on probation or had been released from County Jail, for felony or misdemeanor. All subjects were administered the Structured Clinical Interview for DSM-IV-TR Axis I Disorders-Non-Patient Version to confirm the absence of psychiatric disorders. Participants who met diagnostic criteria for drug or alcohol abuse in the last six months, tested positive on urine toxicology screens, were not included in the study. This strategy was adopted so that the differences between the two groups would not be confounded by drug/alcohol use.

We used the Psychopathy Checklist: Screening Version (PCL: SV) (Hart et al., 1995) to evaluate psychopathy. Each item is scored 0, 1, or 2, for a maximum total score of 24. Trained research staff conducted in-depth semi-structured psychosocial interviews and reviewed all available records to complete the PCL:SV ratings. Participants who scored 18 or more on the PCL: SV were included in the P group; HCs had scores of ≤ 10 on the PCL-SV.

The PCL:SV has two different dimensions: the PCL:SV Affective-Interpersonal dimension consisted of superficial charm, grandiosity, deceitfulness, lack of remorse, shallow affect, and failure to accept responsibility; the PCL:SV Impulsive-Antisocial dimension consisted of impulsivity, poor behavioral control, lack of goals, irresponsibility, adolescent antisocial behavior, and adult antisocial behavior

All participants provided written informed consent according to a protocol approved by the local institutional review board, in line with standards of the committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008

2.2. Measures

2.2.1. Go/NoGo task: stimuli and task

During performance of the Go/NoGo Task, subjects were required to respond quickly to Go stimuli, while withholding responses to the second presentation of any stimulus repeated twice in a row (NoGo stimuli). The variant of the response inhibition Go/NoGo task employed here has been well-characterized in prior work (Hester et al., 2004; Kelly et al., 2004; Roche et al., 2005; De Sanctis et al., 2013; Bell et al., 2014, Morie et al., 2014), and is explicitly designed to induce commission errors (false alarms) since Go response tendencies are pre-potent by virtue of the fact that fully 85% of trials require a rapid response. Thus, on the relatively rare 15% of trials where a stimulus repeats, there is a very strong tendency to execute a button press. Experientially, the task is easy to understand, while at the same time it is challenging to execute.

Stimuli for this task consisted of 478 pictures from the International Affective Picture System (IAPS) (Lang et al., 2008), a set of normative photographs. The emotional valence in these pictures has been rated on a scale from 1 (negative) to 9 (positive). The 148 negative pictures depicted attack scenes, mutilated bodies and disgusting objects (valence: 2.56). The 158 neutral pictures