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Testing the left hemisphere activation hypothesis in psychopathic offenders using the Stroop task

Molly Simmonite[a,b,*,1], Carla L. Harenski[a], Michael R. Koenigs[c], Kent A. Kiehl[a,d], David S. Kosson[b]

[a] Mind Research Network, Albuquerque, NM, USA
[b] Rosalind Franklin University of Medicine and Science, North Chicago, IL, USA
[c] University of Wisconsin-Madison, Madison, WI, USA
[d] University of New Mexico, Albuquerque, NM, USA

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ABSTRACT

Prior investigations of selective attention using the Stroop task have indicated individuals with high levels of psychopathic traits show reduced Stroop interference only when there is spatial separation of conflicting information. However, theories of psychopathy such as the left hemisphere activation hypothesis make specific predictions regarding the impact of rewards which have yet to be tested. Ninety-nine incarcerated male participants were assessed for psychopathy trait levels using the Psychopathy Checklist-Revised (PCL-R Hare, 1999) and completed four Stroop task variants, in which the spatial separation of conflicting information and the presence of financial reward/punishment contingencies varied. While the study failed to replicate previous findings of reduced interference on spatially separated Stroop tasks in individuals with high levels of psychopathy, the novel finding of reduced facilitation under reward conditions provides evidence corroborating the left hemisphere activation hypothesis of psychopathy.

1. Introduction

Despite the prominence of conceptualizations of psychopathy that emphasize emotional deficits, the past quarter century has been characterized by a large increase in studies reporting cognitive dysfunction in individuals with psychopathic traits. Numerous studies have reported reduced responsiveness to peripheral contingencies, deficient learning of stimulus-reinforcement associations, and poor performance under conditions placing differential demands on left hemisphere attention and motor system resources (Finger et al., 2011; Riser & Kosson, 2013; Zeier, Maxwell, & Newman, 2009).

These studies have led to a resurgence of interest in cognitive perspectives on psychopathy, and among these, perhaps the most influential theoretical perspective is the response modulation hypothesis, which posits that psychopathic offenders are characterized by a reduced attention to peripheral cues that signal the need to change behavior in the midst of a dominant response (e.g., Patterson & Newman, 1993).

Among the many paradigms employed to test this hypothesis, studies using the Stroop task have proven especially useful, based in part on the extensive literature addressing the mechanisms underlying the Stroop task effect. In the classic version of the Stroop task, participants are asked to name the ink color of a word that spells a color name. In some cases, the color of the ink and the word are congruent; in other cases; they are incongruent. More difficulties are experienced during the incongruent condition, and this can be measured as an increase in reaction times, or a decrease in accuracy rates (the Stroop interference effect). In contrast, reaction times are decreased and accuracy increased in the congruent condition compared with a neutral condition (in which the word does not refer to a color). This is known as the Stroop facilitation effect. The implications of these differences is that task-irrelevant semantic information (i.e., the meaning of the word “BLUE”) is processed despite the deployment of voluntary attention to processing stimulus color.

Newman and colleagues have demonstrated that psychopathic offenders and non-psychopathic offenders exhibit comparable interference on the traditional Stroop task (Hiatt, Schmitt, & Newman, 2004; Smith, Arnett, & Newman, 1992). However, when completing a variant of the task in which participants name the color of a rectangular frame that surrounds color words presented in black (the box Stroop; see Fig. 1), non-psychopathic offenders continue to display substantial interference when the color of the rectangular frame differs from the meaning of a color word despite the spatial division between the color

* Corresponding author at: University of Michigan, Department of Psychology, 530 Church Street, Ann Arbor, MI 48018, USA.
E-mail address: mollysimmonite@gmail.com (M. Simmonite).
[1] University of Michigan, Ann Arbor, Michigan, USA.

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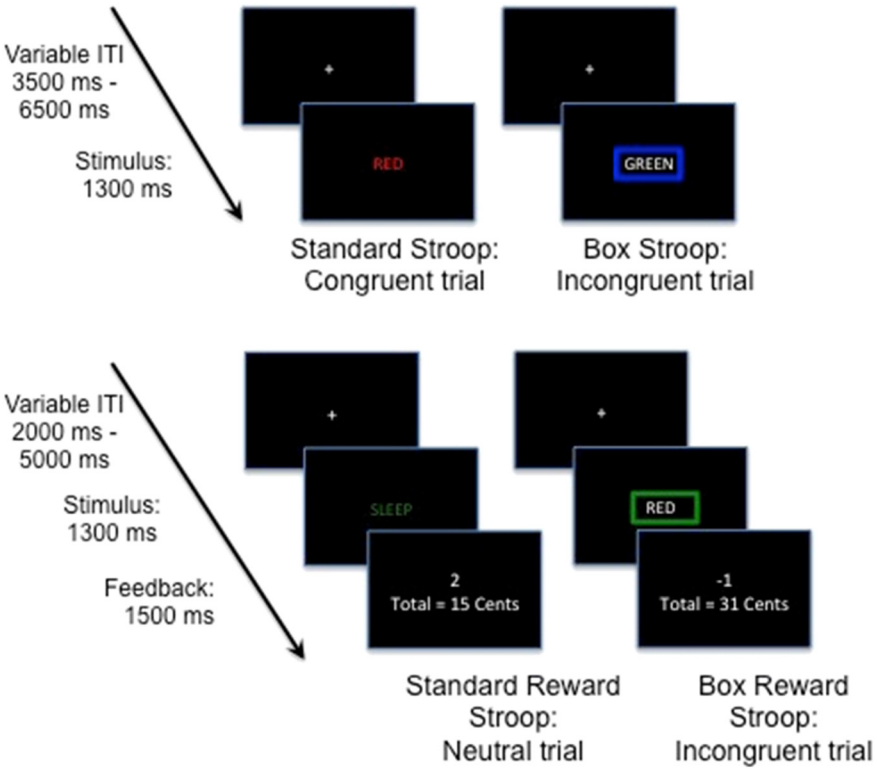

Fig. 1. Examples of trials presented.

word and the distracting information – the frame color. In contrast, psychopathic traits have been linked to lower levels of such interference relative to non-psychopathic offenders. In the first study exploring the Stroop effect in psychopathic offenders, reduced interference was found only in psychopathic offenders with low levels of negative affectivity (Hiatt et al. (2004). In a replication, Hamilton, Baskin-Sommers, and Newman (2014) reported a direct relationship between psychopathic traits and reduced interference. This relationship has been interpreted as consistent with the proposal that psychopathic individuals allocate less automatic attention to semantic processing when their task set prompts them to attend to information even only slightly separated from word stimuli.

As described, within the Stroop task, attentional interference effects can be differentiated from facilitation effects, and these processes appear to depend on different mechanisms (e.g., Brown, 2011). Both prior studies of psychopathy that have addressed the interference-facilitation distinction have suggested that psychopathy is associated with reduced interference but not with increased facilitation (Hamilton et al., 2014; Hiatt et al., 2004).

The Stroop paradigm could potentially be manipulated to test other models of psychopathy. In particular, the left hemisphere activation hypothesis suggests that several psychopathy-related performance deficits depend on manipulations that induce approach motivational states (that is, states in which people are motivated to approach rewarding stimuli, e.g., Kosson, Miller, Byrnes, & Leveroni, 2007; Lopez, Kosson, Weissman, & Banich, 2007), with a large body of research suggesting that the left hemisphere is specialized for approach motivational states and the right hemisphere specialized for avoidance states (e.g. Harmon-Jones, Gable, & Peterson, 2010; Spielberg, Heller, & Miller, 2013). According to this perspective, psychopathic offenders are characterized by performance inefficiency under conditions that place differential demands on left hemisphere-lateralized resources. Studies employing a variety of different paradigms (divided visual field studies, dichotic listening studies, global-local paradigms) have provided evidence for impairments specific to conditions placing greater demands on left hemisphere attention and motor resources. In most of these studies, participants have been incentivized through the use of performance-based incentives. Moreover, several studies suggest that psychopathic offenders' behavioral deficits may be especially robust in situations involving concrete rewards and punishments (Arnett, Smith, & Newman, 1997; Newman, Kosson, & Patterson, 1992).

These perspectives raise questions about the impact of task parameters and rewards on the performance of individuals high in psychopathic traits, with the left hemisphere activation hypothesis predicting that psychopathic offenders will perform especially inefficiently under conditions presenting tangible performance-based rewards. However, no prior Stroop studies examining psychopathic offenders have used rewards to test these hypotheses. As a better understanding of the nature of attentional differences associated with psychopathy may ultimately help pinpoint the mechanisms underlying psychopathic traits, the current study was designed to address: 1) the specificity of reduced interference to Box Stroop conditions; 2) the generalizability of the observed effects to a new sample of offenders; 3) the impact (or lack thereof) of an incentive manipulation designed to increase approach motivation, and therefore elicit abnormalities in individuals high in psychopathic traits.

2. Methods

2.1. Participants

Participants were 99 incarcerated males recruited from a medium-security North American correctional facility that volunteered for the study and provided informed consent. Procedures were approved by the Institutional Review Board of [identifying information removed]. Participants received monetary compensation for participation. Participants qualified for inclusion in the study if they were aged 18–55, had been convicted of felonies, were fluent in English, had a reading level of at least 4th grade and an IQ of at least 70. Additionally, since the data were collected as part of a larger study with included