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# Executive function in psychopathy: The Tower of London, Brixton Spatial Anticipation and the Hayling Sentence Completion Tests

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## ABSTRACT

Executive dysfunction in those high on traits of psychopathy has often been reported, with many disagreements as to the nature of the dysfunction. We aimed to see if tests of planning and rule acquisition/adherence would discriminate those high on psychopathic traits. A battery of executive function tests (Tower of London, Brixton Spatial Anticipation, and Hayling Sentence Completion Tasks) was given to 28 British male prisoners. Psychopathy was measured using the Psychopathy Checklist-Revised. High psychopathy was related to reduced planning in the Tower of London Test and poor rule-adherence on the Brixton Test. Other tests of executive function were not related to psychopathy. The results appear supportive of the notion that function of the orbitofrontal cortex (OFC) is dysfunctional in psychopathy whilst that of the dorsolateral prefrontal cortex (DLPFC) is normal and suggest that impulsivity in those high on psychopathy traits impedes planning and rule following. We suggest the adapted Tower of London Test and the Brixton Test could be useful objective measures of this type of impulsivity in offenders which could help identify key treatment goals.

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## 1. Introduction

The notion that there may be neuropsychological deficits, and in particular deficits in executive functions related to the frontal lobes,<sup>1</sup> in those with antisocial and criminal traits has a long history (Harlow, 1848). The link between psychopathy and possible frontal lobe dysfunction arose from observations of similarities between individuals with acquired frontal lobe damage and those with psychopathy. This led to the coining of the terms ‘pseudo-psychopathy’ (Blumer and Benson, 1975) and ‘acquired sociopathy’ (Damasio et al., 1987) that describe personality and behaviour changes that follow injury to the frontal lobes, involving reduced inhibition of responses, mood instability and reduced social reciprocity.

Early findings from studies of executive function in psychopathy were equivocal, with some studies reporting a range of deficits amongst psychopaths in performance on common neuropsychological tests. A number of studies, however, reported no differences between psychopathic offenders and either normal individuals or people with

other clinical conditions (see Brower and Price, 2001; Hare, 1984; Hart et al., 1990; Morgan and Lilienfeld, 2000).

The lack of consistent findings could be explained by two important variables that were not always carefully considered in previous research: (1) variance in the definitions of psychopathy, (2) poor sensitivity and/or specificity of the tests.

### 1.1. Variance in definition of psychopathy

The definition of antisocial behaviour has not been consistent across studies. Of importance is the distinction between antisocial personality disorder and that of psychopathy. Distinctions have been made at various levels between these groups (Hare and Neumann, 2008; Hart and Hare, 1996) and there may be reasons to suspect that there may be both similarities and differences in their underlying aetiologies and neurophysiological correlates. Thus, deficits found in people with antisocial personality disorder may, or may not, be found in people with psychopathy, and vice versa.

It has been suggested that there are subfactors to the overall concept of psychopathy. The Psychopathy Checklist Revised (PCL-R: Hare, 2003) is a well validated measure of psychopathy that is often used in both research and clinical/forensic settings. Studies of the PCL-R reveal a factor structure showing that two moderately correlated factors define psychopathy. Factor 1 describes affective and interpersonal deficits such as lack of empathy, pathological

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<sup>1</sup> The terms “executive function” and “frontal lobe function” have become nearly synonymous (see Alvarez and Emory, 2006).

lying, lack of remorse, and manipulativeness. Factor 2 describes behavioural and lifestyle deficits such as impulsivity, criminality, and poor behavioural controls. Many previous studies have shown that these two factors can have quite different relationships to outcome measures (see Snowden and Gray, 2010; Vanman et al., 2003). Hence, there may be different patterns of executive function impairment associated with the two factors of psychopathy and studies should examine which aspects of psychopathy are related to any posited executive function impairments.

### 1.2. Sensitivity and specificity of selected tests

Many commonly used tests of executive function are designed to be used with people with marked clinical problems such as dementia or traumatic brain injury. They are, therefore, designed to measure quite profound loss of function and may not have the sensitivity to detect more subtle, lifelong deficits that might be more characteristic of people with psychopathy.

There has been much debate as to whether many tests of executive function are merely tests of intelligence, especially fluid intelligence (de Frias et al., 2006; Rabbitt and Lowe, 2000). The relationship between intelligence and psychopathy was originally thought to be negligible (Hare, 2003; Walsh et al., 2004). However, more recent studies have shown that different sub-facets of psychopathy may well have relationships with measured IQ. For example, Vitacco et al. (2008) show that the components of psychopathy related to an impulsive lifestyle and to antisocial behaviours are inversely related to IQ score, whilst those related to interpersonal style are positively related (see also Copestake et al., 2013). Hence, some of the “executive function” deficits described in previous studies may reflect differences in intelligence as many studies did not provide an independent measure of intelligence. Therefore, we also took measures of IQ in order to see if any executive function impairments found could be accounted for by general intelligence.

Many of the early tests of executive function in psychopaths used general test batteries. Most tests of executive function involve multiple areas of the frontal lobes and associated neural pathways. Lapierre et al., (1995) administered a relatively large battery of well-established neuropsychological tests to prison inmates. They found significant differences, and large effect sizes, between psychopathic and non-psychopathic inmates on commission errors for the Go/NoGo task (i.e., responding when they were meant to withhold the response) and for the qualitative score on the Porteus Maze Test (i.e., breaking the rules of the maze, such as going over the ‘walls’ of the maze) but not for several other neuropsychological tests (for instance, the Wisconsin Card Sort Test). They suggest that the tasks that tap into poor impulse control are affected in those with psychopathic traits and relate this to possible orbitofrontal and/or ventromedial areas of the frontal cortex. Others have also provided support for the notion that tasks that are sensitive to dysfunction in orbitofrontal cortex are often affected in those with psychopathic traits. (Blair et al., 2006; Gao et al., 2009; Mitchell et al., 2002; Yang and Raine, 2009), and this has been extended to community samples using psychometrically defined traits of psychopathy (Snowden et al., 2013).

Impulsivity is a cardinal feature of psychopathy, reflected in several items on the PCL-R, for example, Item 10, Poor Behavioural Controls, and Item 14 Impulsivity as well as other items describing aspects of lifestyle impulsivity (see, for example, Hart and Dempster, 1997). However, not all psychopaths self-report that they are impulsive (Snowden and Gray, 2011), and many of their crimes appear instrumental and planned (Woodworth and Porter, 2002). Clearly, a better understanding of the nature of impulsivity and its possible dysfunction in psychopathy is needed. Current,

however, it appears that tests that are more specific to functions such as planning, impulsivity and rule-breaking are likely to be affected in psychopathy, whilst other executive functions (such as working memory and response interference) are not affected.

### 1.3. Aims of the study

Researchers and clinicians need tests that are sensitive indices of the specific impairments associated with psychopathy. Level of risk, and understanding the factors associated with risk, including neuropsychological function, are of particular interest in the assessment, treatment and management of people with psychopathy. Further elaboration of the pattern of deficits associated with psychopathy in closed testing conditions may support the identification of more individualised treatment targets, management strategies and outcome measurement. Given the limited range of neuropsychological tasks that have so far been studied in psychopathic offenders, we decided to test a battery of neuropsychological tasks commonly used in clinical settings but not previously or extensively reported in studies of psychopathy.

We identified three tasks that we thought might be suitable proxy measures for impulsivity, namely: planning impulsivity (Tower of London Test), inhibition of a prepotent response (Hayling Test), and adherence to rules (Brixton Test). We hypothesised that those high on traits of psychopathy would perform worse on these tests but would not show impairments on tests associated with more general aspects of executive function.

### 1.4. Adapted Tower of London Test

The Tower of London Test was designed to measure deficits in planning associated with frontal lobe lesions (Shallice, 1982). In the adapted version of the Tower of London (Andres and Van der Linden, 2001) the task additionally contains a “misleading condition”. In this misleading condition, moving the first bead into the apparently correct final position is an erroneous strategy that effectively blocks the correct solution to the problem, requiring the respondent to back track to the original start position, therefore leading to increased errors on the task. In addition, a facilitative condition allows the first bead to be correctly placed in its final position requiring the participant to plan ahead in order to discriminate between these two conditions and achieve the optimal solution. A proneness to respond impulsively to the misleading conditions on the first move would be expected to increase the number of moves taken to solve the problem in the misleading trials. Problems in considering consequences and acting impulsively are traits associated with psychopathy (Hare, 2003) that may reflect deficits in evaluating the value of choices and inhibiting inclinations to immediate reward. These individuals would not plan sufficiently in the Tower of London Test and would be likely to succumb to the immediate option of moving a bead directly to its final position regardless of whether this was likely to be a correct or misleading option. This should be manifest in shorter planning times, and in a greater number of moves in the misleading trials.

There has only been one previous attempt to examine the performance of psychopathic individuals on the adapted Tower of London Test. Pham et al. (2003) found that psychopathic individuals did not differ from non-psychopathic individuals on planning time, nor did they differ on the facilitative trials. However, they note that psychopathic individuals took longer to complete the problem and made more errors on the misleading trials.

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