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Executive function in psychopathy: The tower of London, Brixton spatial anticipation and the Hayling sentence completion tests

Ruth Bagshaw a, Nicola S. Gray b, Robert J. Snowden c

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Psychopaths had small planning times on the Tower of London.
Psychopaths had more rule breaking errors on the Brixton spatial anticipation test.
Results are consistent with OFC, but not DLPFC, dysfunction in psychopathy.

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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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Q1 1. Introduction

The notion that there may be neuropsychological deficits, and in particular deficits in executive functions related to the frontal lobes, 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
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 commis-
sion 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 psychopa-
thy. Further elaboration of the pattern of deficits associated with
psychopathy in closed testing conditions may support the identi-
fication of more individualised treatment targets, management
strategies and outcome measurement. Given the limited range of
neuropsychological tests that have so far been studied in psycho-
pathic offenders, we decided to test a battery of neuropsycholo-
gical 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 (Hay-
ling 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 indivi-
duals did not differ from non-psychopathic individuals on plan-
nning 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.
1.5. The Brixton spatial anticipation test

The Brixton Spatial Anticipation Test (Burgess and Shallice, 1996) is a visual analogue of the Wisconsin Card Sort Test (WCST) that relies on inductive reasoning. It contains both the components of acquiring the new rule each time the rule changes (and hence not perseverating on the old rule), and also maintaining the rule once acquired (rule adherence).

It has been suggested that impulsivity leading to excessively rapid responding could be responsible, in some patients, for the higher number of rule adherence errors (Burgess and Shallice, 1996; Miller and Milner, 1985). Such rule adherence errors had been observed in a small scale, unpublished service evaluation by one of the authors that showed that individuals with impulse control disorders commonly produced rule adherence errors and often verbalised a strategy of trying to ‘beat the system’ by changing their response before the rule changes. This behaviour appears analogous to the reward discounting behaviour of psychopathic individuals on the Iowa Gambling task which is mediated by the OFC (van Honk et al., 2002). We predicted that there will be positive correlation between rule adherence errors and PCL-R score but that there would be no impairment in learning the rule in the first instance and no deficits in perseverative responding.

At present there has been no previous investigation into the relationship between the Brixton test and psychopathy.

1.6. The Hayling sentence completion test

The Hayling test (Burgess and Shallice, 1996) requires the participant to complete sentences with a semantically sensible word (Part A), or with a semantically nonsensical word (Part B). The Hayling test is believed to rest on the ability to inhibit a prepotent response. We predicted that those high in psychopathy would not be able to inhibit this prepotent response and would show a greater number of errors on this task showing deficits of disinhibition. Whilst this test has been examined in several populations, such as those with mood disorders (Frangou et al., 2005), suicidal behaviour (Raust et al., 2007), brain injured patients (Odhub et al., 2005), and patients with Alzheimer’s disease (Belleville et al., 2006), to name but a few, we could find no record of it being administered to those with psychopathy.

2. Method

2.1. Participants

Participants were 29 male prisoners aged between 25 and 54 years and recently admitted to the assessment wing of HMP Grendon in the UK. They had an average of 34 convictions (range 3 to 138) which extended from prolific burglary, to sexual offences and homicide. One participant was withdrawn due to the presence of a seizure disorder for which he required medication. All participants reported themselves as drug free and had undertaken drug screening tests within the six weeks prior to inclusion in the study. All drug screening tests were negative. Twenty eight participants were included in the data analysis, and their details are described in Table 1. An index offence is the offence(s) for which the inmate is currently serving a prison sentence. Thirteen participants had index offences involving serious violence, including homicide, assault and robbery. Seven participants had index offences involving serious sexual assaults against adults including rape. Four participants had index offences involving sexual assaults against children.

One participant was not able to complete the full assessment battery due to the session over-running and all prisoners on the wing returning to their cells for a period known as ‘lock down’.

This participant did not complete the adapted Tower of London Test. Thus, 27 data sets were used in the analysis of the adapted Tower of London Test and 28 data sets were included in all other analyses.

HMP Grendon provides a therapeutic community approach for offenders with personality disorders who have committed serious crimes (see Hobson and Shine, 1998). One of the criteria for admission to the community is that the inmate must not be taking any psychotropic medication, and that they are free from drug-related problems. All inmates are regularly tested for drug use and any that are found to fail such tests are removed from the treatment programme. Thus although our sample size was modest (though in keeping with similar studies of this nature – e.g. Lapierre et al., 1995; Mitchell et al., 2002; Pham et al. 2003) we had the advantage of studying a population that had a wide range of PCL-R scores and was relatively unaffected by the influence of current medication or illegal drugs on executive function.

2.2. Ethics

Ethical approval was obtained from both HMP Grendon’s Research Assessment Group and Cardiff University Ethics Committee. All participants were judged by the Responsible Clinician of the prison to be suitable to be approached and invited to participate and able to give informed consent. None of the staff of the prison were directly involved in the study and assessments were not observed by any prison staff. All participants gave written informed consent to participate in the study.

2.3. Materials

2.3.1. Psychopathy checklist-revised (PCL-R)

Psychopathy was measured using the PCL-R (Hare, 2003) The PCL-R contains 20 items that are rated by a clinician after a full file review and interview with the patient. Total scores range from 0 to 40. A large body of evidence suggests that the PCL-R consists of 2 factors relating to Interpersonal and Affective components (Factor 1) and Lifestyle and Antisocial components (Factor 2).

PCL-Rs were completed by one of two individual raters. The rates were trained and supervised on the PCL-R by NSG, an experienced trainer of the PCL-R. From this larger sample we obtained PCL-R ratings from two independent raters for a sub-sample of 17 offenders. Interclass correlations were very high ($R_{Total}=0.98; R_{Factor1}=0.98; R_{Factor2}=0.97$). The 28 participants for whom we collected neuropsychological data were part of a larger research sample.

2.3.2. Wechsler abbreviated scale for intelligence (WASI)

The WASI (Wechsler, 1999) was used to measure general intellectual ability. The four subtest version was used in this study, comprising tests of vocabulary, abstract verbal reasoning (Similarities test), visuospatial/ constructional skills (Block Design test)

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<td>PCL-R total score (0–40)</td>
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<td>Factor 1 (0–16)</td>
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<td>Full scale IQ</td>
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<tr>
<td>Verbal IQ</td>
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<tr>
<td>Performance IQ</td>
<td>98.04</td>
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<td>Total adult convictions</td>
<td>34.64</td>
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and abstract non verbal reasoning (Matrix Reasoning test). The four subtest version allows the calculation of Verbal, Performance and Full Scale IQ.

2.3.3. Adapted tower of London test

The version of the Tower of London Test we used is based on Shallice (1982) and uses three beads and three unequally sized posts that can support one, two or three beads, respectively. The beads are placed in a starting configuration and the respondent has to move the beads one at a time to produce a target configuration whilst maintaining rules about only moving one bead at a time and only onto a post that has a space available. In this study we tested four levels of task difficulty: 3, 4, 5 and 6-move conditions. We also included the facilitative and the misleading conditions of Andres and Van der Linden (2001).

The adapted Tower of London provides three measures; (1) Planning time - the time from presentation of the item to the first move being initiated; (2) Errors - the number of moves in excess of the minimum possible to achieve the solution, and; (3) Action time - the time taken to complete the task once the first move is initiated. In the present study we were only interested in the Planning Time for most of the conditions, but also for the number of moves in the misleading condition.

2.3.4. The Brixton spatial anticipation test

The Brixton test (Burgess and Shallice, 1997) involves detecting a series of abstract rules that predict the location of a target circle in an array of ten circles across 50 trials. The rule governing where the target circle appears next changes unpredictably. Respondents have to detect and apply the new rule until it changes again.

We operationalised two types of errors on the Brixton test. Rule detection errors were counted as those errors following a rule change. Rule adherence errors were counted as errors that followed two or more consecutive correct responses where the rule had not changed.

2.3.5. The Hayling sentence completion test

The Hayling test (Burgess and Shallice, 1997) requires the participant to complete sentences with a semantically sensible word (Part A), or with a semantically nonsensical word (Part B). Hence, in part B the participant has to withhold a prepotent response and generate a new response. The dependent measures are the time taken to initiate a response in Parts A and B and the number of errors made. The number of errors are used to produce a scaled score (from 10–1) where the fewest errors are given the largest score.

2.4. Procedure

Participants undertook a single testing session with the first author during which the neuropsychological test battery was administered. The information sheet that had been provided at the time of recruitment was re-presented prior to the commencement of testing and any questions were answered. Prison officers were able to observe the testing session from outside the room and participants were able to terminate or pause the session if they wished to.

The test battery was administered in a specified order (WASI, Hayling, Brixton, and Tower of London), with an attempt to alternate verbal and visuospatial tasks. Participants were offered a break at the half way point to counter any effects of fatigue. Some other neuropsychological tests were also administered but are not presented here.

2.5. Statistical analysis

There is now good evidence that psychopathy as defined by the PCL-R should be regarded as a dimension rather than a taxon (Edens et al., 2006; Walters et al., 2007). Hence, we did not group our participants into psychopathic versus non-psychopathic for the main analyses but chose to use a correlational analysis that preserves the dimensional nature of the psychopathy construct (see MacCallum et al., 2002).

All variables were inspected for the assumptions of a normal distribution. Data from the PCL-R, the Tower of London, and the Brixton test were deemed not to violate the assumptions of normality. However, the data from the Hayling Test showed a strong positive skew for the RT data and a distinct bimodal distribution (that reflected an overabundance of both minimum and maximum scores). These were not eliminated by data transformations. Hence, analyses that involved data from the Hayling test used non-parametric statistics (i.e., Spearman’s rank correlation). Correlations were compared by the techniques described by Steiger (1980).

3. Results

3.1. Psychopathy and IQ

The descriptive statistics for psychopathy and IQ scores are shown in Table 1. Psychopathy was not significantly related to IQ ($r = -0.04$; ns). This finding is consistent with other studies (Vitacco et al., 2005) that have found no association between psychopathy and intelligence. Further examination of all relationships between IQ (Total, Verbal and Performance) and PCL-R (Total, Factor 1, and Factor 2) all showed small correlations.
(rs < 0.10) and none were significant. Nevertheless, we also
(where possible) repeated the analysis while partia ling out the
effects of IQ in order to rule out any separate association between
IQ and performance on the tests of executive function.

3.2. Tower of London and psychopathy

Table 2 shows the correlations between the TOL scores and
levels of psychopathy. It is noticeable that all the correlations
relating to PCL-R and planning time were negative and many were
significant and of a ”large” effect size (Cohen, 1992). We repeated
this analysis while partia ling out the effects of IQ. The results
changed very little.

We had also hypothesised that a failure to plan would lead to a
greater number of moves in the misleading 5-move condition.
PCL-R scores correlated signi cantly with number of moves in the
misleading condition (r = 0.45, p < 0.05), further, as expected,
number of moves was not related to psychopathy in the facilitating
condition (r = – 0.04, ns).

Given the strong effect of PCL-R score on the planning time we
attempted to examine which aspects of psychopathy were asso-
ciated with this reduced planning time. An examination of each of
the factors of psychopathy showed that both Factor 1 and Factor
2 appeared to be negatively related to planning time, with some
hint that Factor 1 showed slightly greater effects. For the 5-move
problem the correlations differed signi cantly (p < 0.05). We also
examined the unique variance accounted for by each factor and
these are shown in italics. The relationship between Factor 1 and
poor planning time remained, but was much reduced for Factor 2.
The correlations differed for the 4, 5 and 6 move problems
(ps < 0.05).

3.3. Brixton spatial anticipation test and psychopathy

The results of this test are presented in Table 2. Overall
performance was in the “moderate average” range as de ned by
the manual. As hypothesised, total PCL-R score was positively
related to the number of rule adherence errors, producing a
“moderate” effect size (Cohen, 1992). Though not hypothesised,
there was a signi cant negative relationship between PCL-R score
and the number of rule detection errors, which means those with
a high PCL-R score acquired the change of rule of how the counter
moved faster than those with low scores.

Examination at the level of the factors of the PCL-R did not
reveal any speci c pattern. Both Factor 1 and Factor 2 were
positively correlated with the Rule Adherence errors with similar
effect sizes. Both Factor 1 and Factor 2 were negatively correlated
with the rule detection errors with similar effect sizes.

3.4. Hayling sentence completion test and psychopathy

The results of this test are presented in Table 2. Performance on
Parts A and B was in the “average” range, while errors on Part B
was in the “low average” range as de ned by the manual. No
results relating performance to psychopathy achieved a satisfac-
tory level of statistical signi cance. However, we do note that
Factor 2 appears to have a moderate negative correlation that
approached signi cance (p = 0.051) with the number of errors
scaled score (suggesting that those with high Factor 2 scores had
di culty in withholding the prepotent response).

4. Discussion

In this sample of male prisoners we were able to show
substantial dysfunction in planning on the adapted Tower of
London test as a function of psychopathy total score. Those with
a high psychopathy score appear to spend little time planning how
to complete the problem, especially as the problem gets more
difficult. This ‘impulsive’ behaviour in turn also led to a greater
number of errors in completing the task under conditions where
there appears to be an obvious irst move but this move is actually
disadvantageous. For the Brixton Spatial Anticipation task, we
found that psychopathy did not lead to any impairment in
acquiring the rules but that it was associated with later rule
breaking after the rule was acquired. No signi cant results
emerged from the Hayling test.

4.1. Tower of London and psychopathy

Our results using the Tower of London test are not in agree-
ment with those of Pham et al. (2003). They were unable to
demonstrate any changes in planning time on a 5-move version of
this task in those high on psychopathy, but did note that the
psychopathic group made more errors when exposed to the
misleading condition – a result that we also found. The reasons
for the differences between the studies is unclear, though we note
that Pham et al. report possible confounds, such as the control
group having a higher IQ score than the psychopathic group, and
the psychopathic group had more drug use than the controls. Both
of these confounding factors may have served to slow their
psychopathic groups’ planning and thus reduce any sign of the
impulsive behaviour we demonstrate here. Clearly further studies
are needed to resolve this issue.

Several aspects of frontal lobe function have been implicated in
the Tower of London task (Carlin et al., 2000; Unterrainer et al.,
2004; Wagner et al., 2006) as well as other cortical areas. Principal
amongst these areas is the dorsolateral prefrontal cortex (DLPFC),
and, therefore, if psychopathy is associated with dysfunction in
this area, we might expect de cts in the Tower of London Test.
In past research using the Tower of London Test, damage to the
frontal regions has been associated with longer planning times
(Carlin et al., 2000). However, our results indicate smaller planning
times not larger ones. Hence, one could interpret this faster
planning time as indicative of either a different type of executive
function de cit, or even as evidence of an executive function
strength! The latter hypothesis seems unlikely to be the correct
interpretation as decreased planning time in psychopathic individ-
uals appears to be accompanied by an increase in the number of
errors and a failure to modi y this behaviour in light of negative
consequences. Instead, our ndings suggest that the psychopathic
individuals acted in an ‘impulsive’ manner, commencing the
problem without formulating a plan of how to solve the task or
discriminating between two conditions affecting placement of the
irst bead. Lack of planning and behavioural impulsivity are
speci c items on the PCL-R. However, these items load on Factor
2 and our results show a stronger association with Factor 1. A
possible explanation of this could be the crucial role of inter-
personal and a ective de cts in psychopathy that may be impli-
cated in de cient response modulation (Newman et al., 1987). This
theory suggests that impulsive behaviour re ects di culties in the
automatic switching of attention which then interferes with the
ability to assimilate unattended events and potentially relevant
information while engaged in the organisation and implementa-
tion of goal directed behaviour. It is thought to be an attentional
de cit that reduces behavioural inhibition once behavioural acti-
vation is occurring (see Hart and Dempster, 1997). Our results may
offer support for the model of de cient response modulation in

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psychopathy (Newman et al., 1987; Wallace et al., 1999; Lorenz and Newmann, 2002). Planning time on the Tower of London Test and the number of moves for the misleading condition, may therefore prove to be a useful neuropsychological indicator of the executive functions underpinning deficient response modulation in those high on traits of psychopathy.

4.2. Brixton spatial anticipation test and psychopathy

Psychopathic individuals appear to have no problems in learning the rule that governs the movement of the circle or switching when this rule changes. Indeed, those with higher psychopathy scores appear to be able to switch rules better as they made fewer errors on this part of the task. This is consistent with the many reports of intact performance for psychopathic offenders on similar tasks that require rule learning and switching to new rules, such as the Wisconsin Card Sort Test (Ishikawa et al., 2001; Lapiere et al., 1995) and is thought to be indicative of intact function in the DLPFC (Milner, 1963; Monchi et al., 2001). On the other hand, we found that psychopathy was associated with an increase in rule adherence errors (breaking an already acquired rule before it has changed). While such errors could be due to factors such as poor working memory, there is no evidence from other paradigms of such memory deficits in psychopathy (Hansen et al., 2007; Sreenivasan et al., 2008). Instead, it appears that these rule adherence errors are evidence of faulty judgement of the value of the choice and impaired inhibitory control of inclinations to take an immediate reward whereby the person attempts to preempt the possible change of rule and fails to modify their behaviour in light of negative consequences. Several participants in this present study verbalised a strategy of trying to anticipate the next rule change and ‘beat the system’. Such rule-breaking behaviour in psychopathic individuals has also been observed on the Porteus-maze task (Lapiere et al., 1995; Pham et al., 2003; Roussy and Toupin, 2000); and appears similar to the risky decision making of psychopathic individuals on the Iowa Gambling task (Losel and Schmucker, 2004; Mitchell et al., 2002; van Honk et al., 2002) where they appear to continue to choose from the losing packs of cards despite their knowledge that this is a poor strategy overall. Both these types of qualitative errors on the Porteus Maze and risky decision making on the Iowa Gambling task are thought to be indicators of orbitofrontal cortex (OFC) dysfunction, and we speculate that rule adherence errors on the Brixton Test may also be indicative of this. However, to date there have been no neuropsychological or neuroimaging studies that can confirm or refute this hypothesis.

Interestingly, the association between rule adherence and the PCL-R did not show the same Factor 1 association as the Tower of London test. We think this may be because the task provides a less immediately primed impulsive response opportunity and is a less complex task overall. The Deficient Response Modulation model would suggest that in such a case the attentional load would be lower, therefore the reduction in behavioural inhibition would be lower and therefore, the mediating role of affective traits in psychopathy would be less marked.

4.3. Limitations

Given the specialised nature of the population under study, the size of our sample was only modest (though in keeping with similar studies of this nature – e.g., Lapiere et al., 1995; Mitchell et al., 2002; Pham et al., 2003). Nevertheless, due to the large effect sizes manifest on the adapted Tower of London Test and Brixton Spatial Anticipation Test, we were able to demonstrate highly significant results and therefore the issue of sample size is not a concern for these tests. However, our small sample size may have led to Type II errors. We note that for the Hayling test the correlation with PCL-R Factor 2 score was of a moderate size (Cohen, 1992) but was not significant. Clearly, if these correlations were to be replicated with a larger sample size they would reach statistical significance.

Our sample only consisted of incarcerated males. In previous research successful psychopathic individuals appear to show some differences in autonomic nervous system function as compared to unsuccessful (i.e. convicted and incarcerated) psychopathic individuals (Ishikawa et al., 2001). There also appears to be some difference in neuropsychological function between male and female psychopaths (Vitale and Newman, 2001). Hence, it would be of interest to assess whether the findings in the present population generalise to these other groups.

The populations that are normally studied in order to understand psychopathy are often associated with substance use problems, and this raises the question of the extent to which any findings might be a result of, or associated with, substance abuse as opposed to psychopathy per se. One advantage of the current sample is that they were maintained in a drug and alcohol-free state and were free of any psychotropic medication (according to the strict rules of the institution). However, this may not remedy any long term effects of previous substance misuse (Bolla et al., 2003). We further note substance-use problems have been shown to have significant effects on rule detection errors on the Brixton Test (Réay et al., 2006), results that were not present as a function of psychopathy in the present study. Hence, we believe we can rule out any current or recent use of substances as a contributory factor to the present findings.

5. Conclusion

We have demonstrated that amongst this group of incarcerated offenders with histories of violent or prolific offending, psychopathy is associated with: poor planning on a complex task (Tower of London), and the inability to adhere to a rule (Brixton Test). The Adapted Tower of London Test and the Brixton Test may be useful additions to the clinical and research armoury of neuropsychological tests for assessing psychopathy-related deficits.

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References


