



The impact of ADHD symptoms on intelligence test achievement and speed of performance

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ABSTRACT

There is evidence of an association between Attention Deficit Hyperactivity Disorder (ADHD) and impaired performance on neuropsychological tests. Nevertheless, there is a dearth of research on this topic, particularly among forensic populations where rates of ADHD are notably high. This study aims to investigate the effect of ADHD symptoms on speed and performance on a non-verbal intellectual test. Forty three Icelandic male prisoners were screened for childhood ADHD using the Wender Utah Rating Scale (WURS), and for adult ADHD using the DSM-IV checklist of symptoms. IQ was measured using the Ravens Standard Progressive Matrices (RSPM) total score, and test completion time was also recorded. Correlations were conducted on the measures and the effect sizes ranged between small (childhood ADHD with RSPM total score and completion time) to large (adult ADHD with childhood symptoms, RSPM total score and completion time).

Multiple regression analysis indicated that intellectual performance was significantly negatively affected by fast test completion time (medium effect size), but even after controlling for this, performance was further impaired by adult ADHD symptoms (large effect size). The results indicate that ADHD symptoms in adulthood adversely affect intellectual test performance above the speed of performance alone.

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1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most commonly diagnosed psychiatric conditions in childhood (Kutcher et al., 2004). Prevalence of ADHD in the general population has recently been estimated at around 5% in childhood (Faraone, Biederman, & Mick, 2006) and it is now accepted that symptoms persist leading to clinically significant impairments in adulthood, with adult prevalence estimated at 1% (Asherson, Kuntsi, & Taylor, 2005). ADHD is defined by symptoms of inattention, impulsivity, and hyperactivity (American Psychiatric Association (APA), 2000), and symptomatic individuals can have difficulties with sustained attention, lack of impulse control or inhibition, over-activity, and following instructions (Barkley, 1998).

ADHD has further been documented as a common comorbidity among individuals with intellectual disability (Buckley et al., 2006). Intellectual measures which have been shown to discriminate ADHD in adults from normal controls include subtests of the Wechsler Scales: Digit-Symbol Coding, Arithmetic, Block Design, Digit Span (Hervey, Epstein, & Curry, 2004; Quinlan,

2001). These are all subtests that rely on speed of processing and/or working memory and which may be affected by the impulsivity and attention deficits characteristic of ADHD. Additionally, increased variability in reaction time has been a consistently reported deficit in children with ADHD (Castellanos & Tannock, 2002; Russell et al., 2006).

In the present study, Raven's Standard Progressive Matrices (RSPM) (Raven, Raven, & Court, 1998) was used. This is a measure of both visuoperception and abstract reasoning, it is easy to administer, is reasonably culturally fair, and is a reliable and valid test of non-verbal intelligence (Lezak, 1995). It is a good measure of fluid (analytical) reasoning that allows people to solve novel problems and it taps into several working memory systems (Prabhakaran, Smith, Desmond, Glover, & Gabrieli, 1997). This test was therefore considered appropriate for the purpose of the present study, although there are available other suitable timed non-verbal tests, including some of the performance subtests of the Wechsler Adult Intelligence Scale (WAIS-R, WAIS-III and WAIS-IV).

Carpenter, Just, and Shell (1990) used computer modelling to analyse the processing involved by college students completing RSPM, and found that the "ability to induce abstract relations and the ability to dynamically manage a large set of problem-solving goals in working memory" (p. 404) are key processes that distinguish between individuals completing the matrices. These are likely to be some of the areas in which individuals with ADHD have

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deficits (Barkley, 1997), thus individuals with ADHD may be disadvantaged on tests that require these skills and scores obtained may not always reflect true deficits. This was evident, for example, in the case of Billy Joe Friend (Gudjonsson & Young, 2006). Prior to trial Billy Joe was reported to have an IQ score of 63, consistent with learning disability, however later testing at appeal indicated a borderline full-scale IQ of 79 and additional testing showed “significant residual problems diagnostic of ADHD in childhood” (p. 213). A neuropsychological expert concluded that Billy Joe’s intellectual deficits were secondary to his ADHD and, at time of the original IQ assessment, ADHD symptoms had prevented him from completing the test at his true intellectual capacity.

There seems to be no conclusive relationship between ADHD and intelligence at present, and research appears to be particularly lacking in forensic populations. Core ADHD symptoms of impulsivity, attention, and behavioural inhibition have been reported to affect performance-based tests in which these behavioural facets are challenged (e.g. Epstein et al., 2003) and an association between speed and accuracy in test situations has also been documented, for example on the Matching Familiar Figures Task ADHD individuals tend to respond quickly but incorrectly (Young & Gudjonsson, 2005). This suggests that ADHD adults may respond to test items impulsively, possibly without giving each one full consideration, thus performing tasks quickly but inaccurately. An important research question is therefore whether current ADHD symptoms are associated with impaired intellectual performance above that of the speed of performance? If this is the case then it suggests that ADHD symptoms adversely affect the efficacy of performance (i.e. abstract problem solving).

The aim of the present study was to examine the relationship between ADHD symptoms and performance on a non-verbal test of intelligence, namely the RSPM (Raven et al., 1998), in a forensic population. Associations of childhood and adulthood ADHD symptoms with completion time and total score on the RSPM were investigated, as well as the effect that adult symptoms have on test performance. It was expected that: (1) longer RSPM test completion times would be negatively correlated with adult ADHD symptoms (H1); (2) total RSPM score would be negatively correlated with adult ADHD symptoms (H2); and (3) longer test-completion times would be positively correlated with high test scores (H3). An exploratory analysis was also conducted in order to investigate whether, when controlling for test completion time, ADHD symptoms were significantly related to the total RSPM score obtained, demonstrating special variance beyond task completion speed.

2. Method

2.1. Design

To investigate the relationship between ADHD symptoms and performance on the RSPM, a within-participants design was used.

2.2. Participants

An initial sample of 73 Icelandic prison inmates participated in the study, of whom 19 did not complete a Wender Utah Rating Screen for childhood ADHD and so were not included in the current analysis as a childhood diagnosis of ADHD is a prerequisite of a possible diagnosis in adulthood. A further eight did not complete the RSPM and so were also not included, and three were excluded because they were female. For the remaining 43 participants ages ranged from 19 to 44 years (mean = 28.9, standard deviation = 6.5), and all were of Caucasian ethnic background. The index offences that led to the current prison sentences being served were split into six categories and the number of participants in each were

as follows; property offence $n = 18$ (42%), drug offence $n = 9$ (21%), violent offence $n = 6$ (14%), sexual offence $n = 4$ (9%), serious traffic violation $n = 3$ (7%), and other offence $n = 3$ (7%). Details of the participants’ ADHD symptoms and personality traits using the Eysenck Personality Questionnaire are in Gudjonsson, Sigurdsson, Young, Newton, and Peersen (2009).

2.3. Measures

2.3.1. Wender Utah Rating Screen (WURS; Ward, Wender, & Reimherr, 1993)

This measure provides an aid for retrospectively diagnosing childhood ADHD. It was originally a 61-item scale including items relating to childhood behaviours and medical health, although the 25-item self-report version of the scale is commonly administered and was the measure used in this study. The items are those originally found to give the greatest mean differences between ADHD patients ($N = 81$) and the non-ADHD control group ($N = 100$, Ward et al., 1993). Items are rated on a 5-point Likert-type scale; 0 = ‘not at all or very slightly’, 1 = ‘mildly’, 2 = ‘moderately’, 3 = ‘quite a bit’, and 4 = ‘very much’. It was found that a cut-off score of 46 or higher correctly identified 86% of adults with ADHD in childhood, and 99% of controls (Ward et al., 1993), and this cut-off was applied in the current study.

2.3.2. Diagnostic statistical manual IV checklist of ADHD symptoms (APA, 1994)

This 18-item self-report checklist measures current symptoms of ADHD in adulthood. It comprises nine items relating to problems with inattention and nine items relating to hyperactivity-impulsivity. The checklist items are in line with the DSM-IV criteria for ADHD (APA, 1994). Each item is scored on a 3-point Likert-type scale; 0 = ‘never’, 1 = ‘sometimes’, and 2 = ‘often’. Only those who had met the cut-off criterion for childhood ADHD as measured by the WURS could obtain a diagnosis of adult ADHD on the DSM-IV checklist. Full adult diagnosis (i.e. being fully symptomatic in adulthood) required that six or more symptoms from the inattention section or six or more symptoms from the hyperactivity/impulsivity section were rated as being present ‘often’ (i.e. scored as 2) in the previous 6 months. Participants were classified as being in partial remission of symptoms if they met criteria for ADHD in childhood and scored 17 or more on the DSM-IV checklist but did not meet criteria for being fully symptomatic in adulthood, as this score equates to one standard deviation above the mean for a non-control group (Young, 1999).

2.3.3. Raven Standard Progressive Matrices (RSPM; Raven et al., 1998)

This is an objective, non-verbal test of analytic intelligence consisting of sixty matrices presented in five sets, A–E. Each matrix test depicts a pattern from which one piece is missing. The participant is required to select the piece which correctly completes the matrix from several given options. Possible scores range from 0 to 60.

2.4. Procedure

Prisoners were provided with an information sheet detailing what the research procedure would entail for them, in order that they could give informed consent to participate. They were informed that their participation would be confidential and anonymous, and that their non-participation would not affect their management or length of stay within the prison. They were informed of their right to withdraw without consequence from the study at any time. For those who consented to take part, two screening measures were used to identify ADHD (the WURS and

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