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ADHD subtypes and neuropsychological performance in an adult sample

Roberta Dobson-Patterson [a], John G. O'Gorman [a], Raymond C.K. Chan [b], David H.K. Shum [a,*]

[a] School of Applied Psychology and Menzies Health Institute Queensland, Griffith University, Brisbane, Australia
[b] Neuropsychology and Applied Cognitive Neuroscience Laboratory, Key Laboratory of Mental Health, Institute of Psychology, Chinese Academy of Sciences, Beijing, China

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ABSTRACT

The study investigated, with an adult sample, the hypothesis that differences between subtypes of ADHD on neuropsychological tests contribute to the poor separation of ADHD and healthy groups on tests of this kind. Groups of ADHD inattentive ($n = 16$) and combined ($n = 16$) subtypes were carefully identified using DSM-IV criteria, and their performance on 14 measures of attention, memory, and executive function (EF) was compared between subtypes and between the two subtypes combined and a group of healthy controls ($n = 30$). Multivariate analyses showed statistically significant differences between the two subtypes, and between the two subtypes combined and the healthy controls. Importantly for the hypothesis, where differences for neuropsychological tests in terms of effect sizes between subtypes were largest, the differences in effect sizes between the two groups combined and controls were smallest ($r = -0.64$, 95% CI [−0.15, −0.87]).

What this paper adds?

The essential contribution of the study is the demonstration that the magnitudes of the differences between adult ADHD groups and healthy controls across a battery of neuropsychological tests are negatively related to the magnitudes of the differences between ADHD subtypes. That is, the differentiation of ADHD adults from controls is poorest where ADHD subtypes are most different. This is an outcome that is logical and conforms to a hypothesis previously advanced to account for the conflict in findings from studies attempting to differentiate ADHD samples from healthy controls. The hypothesis thus gains some support from the present study and the outcome points to the need to account for differences within samples of ADHD adults in studying their performance relative to healthy controls on neuropsychological tests.

1. Introduction

ADHD is a disorder characterised by difficulties in attention, impulsiveness, and over-activity that develops in childhood but is now known to persist into adulthood in more than 50% of cases (Davidson, 2008). The prevalence in adult populations is estimated at around 4% (Kessler et al., 2006), but rates have been variously reported from 2% to 18% (Rowland, Lesesne,

* Corresponding author at: School of Applied Psychology (Mt Gravatt Campus), Griffith University, Mt Gravatt, Queensland 4122, Australia.
E-mail address: d.shum@griffith.edu.au (D.H.K. Shum).

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& Abramowitz, 2002). The symptom picture varies somewhat across individuals, which has led to the proposal that there are subtypes of ADHD. DSM-IV (American Psychiatric Association, 2000), for example, defined the ADHD inattentive type (ADHD-I), the hyperactive type (ADHD-HI), and a type (ADHD-C) that combines features of both the other types. There is factor analytic and genetic evidence to support these distinctions (Woo & Rey, 2005), although a comprehensive review of the literature by Willcutt et al. (2012) raised doubts about the long-term stability of the groupings. In the case of adults, the ADHD-I and ADHD-C types are the most commonly identified, with estimates from large sample studies ($n > 100$) indicating rates of 56–62% for ADHD-C, 31–37% for ADHD-I, and 2–7% for ADHD-HI (Millstein, Wilens, Biederman, & Spencer, 1997; Wilens, Biederman, & Spencer, 2009). Adults diagnosed with ADHD have been found to have poorer psychosocial adjustment than healthy participants (Murphy & Barkley, 1996) and this is reportedly more marked in those diagnosed as ADHD-C than ADHD-I (Murphy, Barkley, & Bush, 2002; but see Sobanski et al., 2008).

Research on the neuropsychology of ADHD has implicated deficits in executive functions (EF) that are not due to intelligence or education (Lange et al., 2014; Pennington & Ozonoff, 1996; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Studies comparing adults with ADHD and healthy controls indicate differences in performance on tests of EF, as well as in other areas, notably attention and memory, but the findings are mixed, with differences in results arising from the assessment tasks used and the heterogeneous nature of the samples employed. Woods, Lovejoy, and Ball (2002) provided a narrative review of 35 studies of ADHD in adults and concluded that there were deficits in divided and sustained attention, verbal fluency, auditory-verbal list learning, planning/organisation, behavioural inhibition/impulsivity, cognitive flexibility, and speed of information processing. Boonstra, Oosterlaan, Sergeant, and Buitelaar (2005) reported a meta-analysis of 13 studies that compared adults with ADHD and healthy controls on EF tests and concluded that there were differences between the groups in verbal fluency, inhibition, and set shifting. A meta-analysis of 33 studies of neuropsychological performance in adults with ADHD by Hervey, Epstein, and Curry (2004) found impairments in a number of functions, with those most marked being in attention, behavioural inhibition, and working memory. A meta-analysis of 24 studies of adults with ADHD by Schoechlin and Engel (2005) found that the largest effect sizes for the differentiation of ADHD from healthy controls were for tests of verbal memory, focussed attention, sustained attention, and abstract verbal problem solving requiring working memory. Tests of visual memory, visual problem solving, and EF resulted in the smallest effect sizes.

Davidson (2008) noted differences between the conclusions of Woods et al. (2002) and Schoechlin and Engel (2005) and suggested that these may have arisen at least partly from differences in how EF is defined and operationalised, given there is no agreed 'set' of EF measures. Schoechlin and Engel (2005) suggested that the existence of diagnostic subgroups (viz. inattentive and hyperactive) within the ADHD samples may confound comparisons and noted that Barkley (1997) had hypothesised differences between these subgroups in terms of EF, memory, and focussed attention. Seidman (2006) reviewed the four studies available at the time that examined differences between subtypes of ADHD in terms of neuropsychological tests and concluded that there were more similarities than differences between subtypes. A later study of adults by Tucha et al. (2008) compared ADHD subtypes on a battery of attention tasks. The patient groups differed from healthy controls in terms of particular measures of vigilance, selective attention, divided attention, and flexibility, but there were few statistically significant differences ($p < 0.05$) between subtypes, although as the authors noted effect sizes for some of the comparisons were medium to large (in terms of Cohen's, 1988 classification).

A recent extensive study of the role of subtype differences, among other factors, in neuropsychological differences between ADHD and healthy children and adolescents was reported by Nikolas and Nigg (2013). They examined subtype differences across a broad range of tasks in a sample of 285 ADHD participants and 213 healthy controls aged 6–17 years. Measures were combined into domains of functioning using confirmatory factor analysis, with the final model selected including a general domain ('cognitive control') subordinating seven more specific domains ('inhibition', 'working memory', 'memory span', 'processing speed', 'response variability', 'arousal/activation', and 'temporal information processing'). ADHD participants classified as ADHD-C performed more poorly than those classified as ADHD-I across all domains of functioning, but there were some interactions with age and gender: differences between subtypes were more likely for boys and for older rather than younger participants.

Given that few studies have been reported to date on subtype differences in neuropsychological functioning for adults and the results of the studies that have been reported are mixed, the study reported here sought to test the hypothesis that differences between ADHD subtypes contribute to the ambiguity in reported differences between ADHD and healthy groups. As noted above, the stability of DSM-IV subtypes has been questioned. In DSM-5, for example, the term 'subtype' has been replaced with 'presentation' in recognition of possible change over time. Lahey, Pelham, Loney, Lee, and Willcutt (2005) reported that substantial numbers of children diagnosed with ADHD changed subtype status over an eight year period. The difference was particularly marked for those classified as ADHD-HI. In commenting on their findings, the authors suggested that the comparison of ADHD-I with the other subtypes, although it may not have value for clinical purposes, was potentially useful for research as this captured, in their view, a 'traitlike difference' in symptoms. Individuals classifiable as ADHD-HI were not used in the present study.

In the present study, careful diagnosis of the two commonly found adult ADHD subtypes (ADHD-I and ADHD-C) was undertaken using a structured clinical interview and rating scales completed by the participant and family. A broad battery of neuropsychological tests was assembled to cover possible differences in performance in attention, memory, and EF and comparisons made with this battery between the ADHD combined groups, the ADHD subtypes, and a group of healthy controls.