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Attention Deficit Hyperactivity Disorder and Executive Function Impairment: An Overview

As with any cognitive ability, attention is vulnerable to dysfunction. The most common attentional problem is attention deficit hyperactivity disorder (ADHD). This brief overview will highlight the symptoms and deficits associated with ADHD, its prevalence in today's society, the association between executive function impairment and ADHD using Barkley's (1997) work, and the personal and societal effects of the disorder.

ADHD has impairing symptoms including inattention, disorganisation, impulsivity, and hyperactivity (American Psychiatric Association [APA], 2013). Other indicators of ADHD include failure to pay attention to detail, the production of thoughtless mistakes, forgetfulness, and the appearance of not listening when spoken to (APA, 2013). There are three main subtypes of ADHD: impulsive type, inattentive type, and combined type. Those with impulsive type display more outward behavioural symptoms of ADHD, such as hyperactivity, fidgeting, excessive movements when the expectation is to be still (i.e., in situations like classrooms or meetings), and disproportionate talking (APA, 2013). Those with ADHD-inattentive type tend not to display these behaviours, but can be more internally distracted, restless, and struggle to stay on task. Those with ADHD-combined type display the symptoms of both the inattentive and the impulsive types.

ADHD is one of the most pervasive psychological conditions in children, and is a prevailing condition in adulthood. Many studies have aimed to determine the exact prevalence of ADHD in society. According to the DSM-5 (APA, 2013), surveys have shown that ADHD exists across cultures, with around 5% of children and 2.5% of adults having the condition. In the USA alone in 2011, 11% of children had been officially diagnosed with ADHD with 6.1% of those children receiving treatment by medication (Centres for Disease Control & Prevention, 2013). Approximately 80% of children with ADHD will also have the condition in adolescence and adulthood. One

systematic literature review found that the worldwide incidence of ADHD was 5.29% (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007).

According to Barkley (1997), there are four main deficits to ADHD. These are: "(a) poor investment and maintenance of effort, (b) poor modulation of arousal to meet situational demands, (c) a strong inclination to seek immediate reinforcement, along with (d) […] difficulties with impulse control" (Barkley, 1997, p.65). It is clear that these four factors corroborate with the symptoms of ADHD. Scholars have also suggested that the impairments apparent in people with ADHD are a result of a deficit in motivation (Glow & Glow, 1979), or due to poor stimulus control and an inability to follow behavioural rules (Barkley, 1981; as cited in Barkley, 1997), however these ideas are not well received in the field, and as a response to this, Barkley (1997) created his 'unified theory' of ADHD.

According to this theory, a proposed cause of ADHD is a deficit in executive function (EF), as EF impairment is often found in individuals with the disorder. Barkley (1997) proposed that poor response inhibition was the main problem, and attributed this to the functioning of the frontal lobes, where EFs are operated from. Inhibition is the "mechanism that reduces or dampens neuronal, mental, or behavioural activity" (Clark, 1996, p.128), and this is thought to play an important role in the management of behaviour. Inhibition can be cognitively assessed by the individual's ability to withhold or delay a response, the termination of an existing response, and resistance to distraction (Barkley, 1997). Barkley (1997) stated that there are four EFs that specifically guide self-regulation and goal-directed behaviour, which depend, at least in part, on successful behavioural inhibition. The four EFs are working memory (e.g., keeping information in mind, and manipulating or using it), self-regulation of affect/motivation/arousal (e.g., emotional, drive, and stimulation control), internalisation of speech (e.g., reasoning, problem solving, and rule following), and reconstitution (e.g., behaviour analysis, verbal/behavioural fluency, creativity) (Barkley, 1997). A deficiency in inhibition leads to an impairment in these four EFs which affects self-regulatory behaviour and behavioural fluency, a lack of which is evident in the symptoms of ADHD.

Support for Barkley's (1997) unified theory was evidenced by Houghton and colleagues (1999). They tested individuals with non-medicated ADHD on five EF tasks

and compared their performance to those in a control group (participants without ADHD). It was found that people with ADHD diverged from the control group on behavioural and response inhibition. As those with ADHD were clear of any comorbid conditions, it was determined that the deficits in EF were an ailment of ADHD itself (Houghton et al., 1999). Furthermore, people with the disorder had significantly more EF impairments than those who did not (Happé, Booth, Charlton, & Hughes, 2006). When tested on the EFs of response inhibition, working memory, and flexibility (akin to Barkley's (1997) reconstitution), it was observed that those with ADHD showed no improvement in EF with age. Interestingly, when a comparison group of individuals with autism spectrum disorder (ASD) was considered, it was established that those with ADHD display more severe and enduring EF deficiencies than those with ASD (including Asperger Syndrome; Happé et al., 2006).

In further support, a meta-analysis of 83 studies that tested those with and without ADHD on measures of EF concluded that those with the disorder had significantly poorer performances on all of the EF tasks utilised (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Medium effect sizes were shown for these findings, with the greatest and most stable deficits being in response inhibition, vigilance, working memory, and planning (Willcutt et al., 2005). The differences could not be explained by variation in IQ or the symptoms of comorbid conditions.

Barkley's (1997) theory, and the research in support of it, shows that the behaviour of those with ADHD is likely to be influenced by situational context, more so than for those without the disorder (Brown, 2013; Houghton et al., 1999). This means that it should not be taken for granted that those with ADHD will have EF impairment irrespective of what they are doing and the context they are in. It is likely that those with ADHD will have a range of tasks that they will be fully able to engage with, without EF decrement, leading to their successful completion. Brown (2013) explained that these tasks are usually of high personal interest to the individual, which therefore catches their attention, resulting in higher levels of concentration. For instance, one may find it very difficult to read an instruction manual, but may have no problem with reading a book from their favourite genre. There is also a second type of situation that would lead to higher levels of focus, which is when the incompletion of a task is perceived to have immediate negative consequences. For example, a student with ADHD may find report writing very challenging and may therefore procrastinate as

much as possible, but when the deadline is closer, they should find it easier to produce the work due to the worry of acquiring a failed assessment.

That some tasks are carried out more successfully than others should not lead to the opinion that those with ADHD have a lack of willpower on the tasks they struggle with. Concentration cannot always be enforced by the person with ADHD as EFs are automatic procedures (Brown, 2013). Factors that are thought to influence this fluctuation in EF performance are contextual and include personal interest, perceived reward/reinforcement, task type and requirements, and internal cognitive and physiological elements (Brown, 2013).

With consideration of the evidence presented, along with the definitions of EFs, and the symptoms of ADHD, it is clear that deficits of EF are related to the attention disorder. What was less clear until recently was if ADHD was triggered by EF impairments, or if EF impairments were triggered by ADHD. A neurological study has determined that the rate of cortical development of the prefrontal regions of the brain is significantly slower in those with ADHD when compared to control individuals (Shaw, Malek, Watson, Sharp, Evans, & Greenstein, 2012). This indicates that it is likely that abnormalities in neural development produce flaws in EF, which in turn could lead to ADHD.

ADHD is a debilitating condition that can affect all areas of an individual's life and can lead to poor academic achievement, low self-esteem, decreased employment opportunities, as well as lower occupational status, poor relationships, anxiety, depression, and substance misuse (Advokat, Lane, & Luo, 2011; APA, 2013; Barkley, 1997). Studies looking at the effect of teacher-based interventions on the behavioural and academic difficulties seen in ADHD children have found that although behaviour can be improved, there are only very small advances to an individual's academic work (Iseman & Naglieri, 2011). In the USA, ADHD is thought to be a significant public health issue and the cause of a substantial financial weight upon both families and society (Polanczyk, et al., 2007).

The various types of medication used to treat ADHD can improve the outward behavioural symptoms, but it can have little or no effect on an individual's ability to learn and utilise knowledge (Advokat et al., 2011). This means that medication can inhibit hyperactivity and fidgeting, but it is unlikely to allow the individual to mentally

focus and pay attention. Furthermore, it has been found that ADHD sufferers find it very difficult to self-motivate, especially if they find tasks mundane and uninteresting, and if there are no immediate benefits from completing the task (Carlson, Booth, Shin, & Canu, 2002). This leads to the individual committing less effort to unexciting tasks than someone without ADHD, who can more easily comply with the necessity of such tasks.

For a long time, ADHD was assumed to be a childhood condition that individuals would grow out of in adolescence. However, it is now being recognised as an encumbering disorder in adulthood too, which can affect social, work, and life quality. For students with ADHD, help is available through disability services at most universities, although the individual may benefit from developing their understanding of the condition and how it applies to them. It would also be worth trying out different study environments and techniques to determine what works best, and frequent deadlines should also be beneficial.

To conclude, ADHD is a widely prevalent psychological condition in both children and adults that carries numerous symptoms, as described in this article. The characteristics of the disorder lead to defects in learning, working, and socialising abilities, which can be detrimental to an individual's quality of life. It has been suggested by Barkley (1997) that EF impairment is a possible cause of ADHD, and supporting evidence for this claim has been illustrated. The research to date on ADHD indicates that there are ways that individuals can cope and succeed in spite of their condition, and further research that aims to develop and refine appropriate and useable learning strategies would be beneficial, especially to students.

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