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# Searching for the attention deficit in attention deficit hyperactivity disorder: The case of visuospatial orienting

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## Abstract

We review all 14 extant studies of covert visuospatial attention in attention deficit hyperactivity disorder (ADHD) (total  $N = 248$ ). Metaanalysis showed that intriguing but isolated findings of alerting or posterior disengage deficits were too small to reliably detect with the sample sizes typically employed. Posterior move and engage operations and the vigilance sustained attention process were normal in ADHD. For exogenous cues, effect sizes for group differences were homogeneously small across all repeated-measures conditions, as were calculations of cost, benefit, and validity effects. For endogenous cues, effect sizes were heterogeneous; however, calculations of cost, benefit, and validity effects were small and homogenous. The most parsimonious conclusion may be that ADHD is not characterized by significant visual orienting dysfunction, but questions remain about the extent of anterior lateralized effects in the combined subtype and about attentional functioning in the inattentive subtype.

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*Keywords:* ADHD; Covert attention; Visuospatial attention

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## 1. Introduction

As its name implies, attention deficit hyperactivity disorder (ADHD) has been thought for at least two decades to involve a possible deficit in attention. The concept of attention within the diagnostic criteria of DSM-IV ([American Psychiatric Association, 1994](#)) is not formally defined in cognitive terms. Instead, behavioral ratings from parents and teachers reliably

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differentiate two symptom domains labeled as inattention-disorganization and hyperactivity-impulsivity (McBurnett et al., 1999). However, behavior that appears as “inattentive,” spacey, off task, and the like, may or may not be traceable to dysfunction in basic cognitive or neural networks that subservise attentional control per se. As others and we have pointed out, such behaviors could be related to a variety of candidate cognitive dysfunctions (Nigg, 2001). Controversy remains in the literature as to whether cognitively defined attentional processes are in fact dysfunctional in ADHD (Barkley, 1997b).

Complicating resolutions of such questions are the changing phenotypic descriptions and diagnostic criteria for ADHD. DSM-III (American Psychiatric Association, 1980) included subtypes of “ADD” with and without hyperactivity. DSM-III-R (American Psychiatric Association, 1987) removed this distinction and described “ADHD” as a single disorder of inattention, hyperactivity, and impulsivity (Faraone, Biederman, Weber, & Russell, 1998). Following multiple studies and extensive field trial investigations that supported a two-factor structure to ADHD symptoms (inattention-disorganization vs. hyperactivity-impulsivity) and clinically meaningful differences between subtypes, DSM-IV (American Psychiatric Association, 1994) returned to subtyping (Faraone et al., 1998; Milich, Balentine, & Lynam, 2001). However, most of the studies reviewed herein relied on DSM-III-R criteria. Unless otherwise specified, when we refer to “ADHD,” we are referring to the disorder in general without regard to subtype.

It may surprise some specialists that we claim the status of attention in ADHD has not already been settled in the negative, while clinicians may be surprised that attention is not an established deficit. Many current theories no longer emphasize attention processes, instead highlighting deficits in executive functions (EF) (Barkley, 1997b), arousal (Zentall & Zentall, 1983), allocation of effort during motor output (Sergeant, Oosterlaan, & van der Meere, 1999), reward response (Newman & Wallace, 1993), or other disturbance (for a review, see Nigg, 2001). Yet, theorists remain concerned about attentional dysfunction in ADHD (e.g., Douglas, 1999), and attentional deficits continue to receive extensive empirical investigation, suggesting that scientists and clinicians remain curious as to the relationship between inattention and ADHD.

The continued interest in attention may be due to several factors including the promise of future assessment tools that can better characterize a core deficit marking the disorder (Neufeld, 2002). More generally, it reflects the movement in the scientific field toward a search for cognitive markers or other endophenotypes that may mark etiologically significant dysfunctions. Advances in cognitive neuroscience, and particularly the development of a model emphasizing component operations involved in visuospatial orienting, have revived the study of attentional processes in ADHD. This model, in turn, derives from seminal work by Posner (1980) and others. After the pioneering study of this model in ADHD by Swanson et al. (1991), 13 studies followed using related although not identical methods. As these efforts have gone forward, it is timely that the status of attentional orienting in ADHD be reviewed.

As context for this review, we note that several other approaches to attention are apparent to even a casual observer of the cognitive neuroscience (and even to some degree the clinical) literature in the past decade. These include new advances in the analysis of load-dependent perceptual processing (Huang-Pollock, Carr, & Nigg, 2002; Lavie, 1995), conflict detection

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