

Predicting the early developmental course of symptoms of attention deficit hyperactivity disorder[☆]

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Abstract

Data from the National Institute of Child Health and Human Development Study of Early Child Care were examined to test whether: attention deficit/hyperactivity disorder (ADHD) symptoms remain stable from 54 months through early elementary school; behavioral inhibition and attention deficits assessed at 54 months predict ADHD symptoms in elementary school, even after controlling for their temporal stability; and early behavioral inhibition and attention deficits moderate the longitudinal stability in ADHD symptoms. Data were examined using continuous and categorical measures of symptoms. Modest stability in ADHD symptoms from 54 months to third grade was found. Measures of inhibition and inattention predicted later teacher ratings uniquely, but no evidence was found for moderation. Measures of preschool behavioral inhibition also predicted “persistently at risk status” defined by elevated teacher ratings over time. Results are discussed in terms of executive and motivational facets of inhibition that may be related to early signs of ADHD.

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1. Introduction

Over the past two decades attention deficit/hyperactivity disorder (ADHD) has become one of the most commonly diagnosed and studied childhood disorders (see, for review, [American Academy of Pediatrics, 2000](#); [Tannock, 1998](#)). Major questions still remain, however, about its etiology and developmental course and about what early indicators may signal risk for the emergence of ADHD ([Rowland, Lesesne, & Abramowitz, 2002](#)).

In the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* ([American Psychiatric Association, 1994](#)), ADHD is defined by symptoms in two primary areas: hyperactivity–impulsivity and inattention. Childhood ADHD is associated with maladjustment in many domains of functioning over the course of development

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(American Academy of Pediatrics, 2000), including academic achievement and social relationships. Overall, children with ADHD disproportionately use medical and mental health services compared with children without ADHD (Rowland et al., 2002). The costly toll that ADHD takes on individual adjustment, family life, schools, and social services underscores the importance of understanding the developmental course of ADHD symptoms, with the ultimate goal of early identification and treatment.

Identifying early markers of ADHD symptomatology and charting its developmental course involve three fundamental tasks. First, the longitudinal stability of ADHD symptoms must be established. Second, potential early markers of ADHD symptoms must be identified. This search should be guided by theoretical models of ADHD and by empirical data. Third, the predictive power of these hypothetical markers must be tested in a community sample across time to avoid the biases associated with clinic referral, especially in young children (e.g., Lahey et al., 2004).

Examining the development of ADHD symptomatology in a community sample also necessitates investigating these questions at the symptom level rather than at the disorder level. Therefore, in the current study, we examine the longitudinal stability of ADHD *symptoms* from 54 months through first and third grades. Then, based on a review of the theoretical literature and empirical research, we explore whether behavioral inhibition and inattention in preschoolers predict ADHD *symptoms* as rated by teachers in first and third grades. In addition, we investigate whether poor behavioral inhibition or inattention in preschool-aged children exacerbates ADHD *symptoms* in early elementary school in children with higher levels of early *symptoms*. Finally, as we are ultimately motivated by our desire to understand attention deficit/hyperactivity *disorder*, we also examine these same questions as a function of elevated ADHD symptom levels across time.

1.1. Longitudinal stability of ADHD

Although several studies have examined the longitudinal stability of early ADHD symptoms (Lahey et al., 2004; Lahey, Pelham, Loney, Lee, & Willcutt, 2005; Pierce, Ewing, & Campbell, 1999), they have not investigated potential mechanisms that may underlie this temporal stability. Lahey et al. (2004) examined the 3-year predictive validity of ADHD in children diagnosed between 4 and 6 years of age using DSM-IV criteria. They found that children who met full diagnostic criteria during their first assessment were likely to continue to meet diagnostic criteria for ADHD over the next 3 years (Lahey et al., 2004). Pierce et al. (1999) found that symptoms of ADHD identified in hard-to-manage preschool boys predicted continuing problems in middle childhood. The present study aims to examine both the stability in ADHD symptoms over time and also to advance current knowledge by examining the role played by potential early markers of ADHD symptoms: behavioral inhibition and inattention.

1.2. Theoretical models of ADHD: The role of inhibition and inattention

Over the past 15 years, several theoretical models of ADHD have emerged (Sergeant, Geurts, Huijbregts, Scheres, & Oosterlaan, 2003). Despite different emphases, these models all posit deficient behavioral inhibition and attention as central features of ADHD, but they differ in the precise definitions and roles of inhibition and attention deficits in the emergence of ADHD. For instance, Barkley (1997) identifies behavioral inhibition as an executive function in the Behavioral Inhibition Model, whereas Sonuga-Barke, Houlberg, and Hall (1994) view poor behavioral inhibition as a symptom of the inability to wait in the Delay Aversion Model. The models differ not only in their definitions, but also in whether they ascribe a primary or secondary role to underlying inhibition and attention deficits (Nigg, 2001). For example, the Behavioral Inhibition Model asserts that ADHD is driven primarily by an inhibition deficit, which, in turn, is responsible for an attention deficit (Barkley, 1997), whereas inhibition and attention deficits are both relegated to secondary roles in the Cognitive-Energetic Model (Sergeant, Oosterlaan, & van der Meere, 1999). On the extreme end of this spectrum lies the Delay Aversion Model (Sonuga-Barke, Dalen, Daley, & Remington, 2002; Sonuga-Barke et al., 1994), which ascribes peripheral roles to both behavioral inhibition and inattention; it suggests that a hypersensitivity to delay is responsible for ADHD symptoms and is partly manifest as impulsive and/or inattentive behavior.

1.3. Behavioral inhibition and inattention

Despite the lack of agreement regarding the definitions of inhibition and inattention and the specific roles they play in the etiology of ADHD, as already noted, some form of inhibition and/or attention deficit is common to nearly all

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