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## Validity of the behavior rating inventory of executive function in children with ADHD and/or Tourette syndrome<sup>☆</sup>

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### Abstract

The dynamic, multidimensional nature of executive function (EF), thought to be characteristically impaired in those with attention deficit hyperactivity disorder (ADHD), has been challenging to operationalize and assess in a clinical setting [Barkley, R. A. (1997). *ADHD and the nature of self-control*. New York: Guilford Press.]. Gioia, Isquith, Guy, and Kenworthy [Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000) *Behavior Rating Inventory of Executive Function*. Odessa, FL: Psychological Assessment Resources.] developed the Behavior Rating Inventory of Executive Function (BRIEF) to address these concerns. In order to provide concurrent validity information on the BRIEF, parents of 76 children (ADHD = 18; Tourette syndrome (TS) = 21; TS + ADHD = 17; controls = 20) completed the BRIEF, additional behavior rating scales and interviews, measures of psychoeducational (PE) competence, and performance-based measures of EF. Both ADHD and TS + ADHD groups were rated as more impaired ( $P < .0001$ ) than the other groups on the five primary BRIEF indices. BRIEF index scores showed no significant correlation with performance-based EF or PE measures, with the exception of math achievement; however, the BRIEF showed a strong relationship with interviews and other parent rating measures of behaviors seen in ADHD. Future attempts to validate the BRIEF should

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focus on differences within subtypes of ADHD (e.g., inattentive, combined subtypes), and separating ADHD from other clinical groups in which EF is reported to be a problem.

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## 1. Introduction

Executive function (EF) is a term used to refer to self-regulatory behaviors necessary to select and sustain actions and guide behavior within the context of goals or rules. In essence, EF involves developing and implementing an approach to performing a task that is not habitually performed. Initiation, planning, shifting of thought or attention, organization, inhibition of inappropriate thought or behavior, and efficiently sustained and sequenced behavior are crucial elements of the EF construct. Inhibition (Barkley, 1997, 2000) and working memory (Pennington, 1997) appear to be fundamental subsystems involved in the development of EF competence. EF is viewed as being supported by a distributed neural network with cortical and subcortical components (Denckla, 1996a; Denckla & Reiss, 1997). This network supports “how and when” functions that range from the more elementary “boredom tolerance” to higher-order problem solving functions. Integrity of these functions is considered critical for compensation of deficits in other domains such as language or visuospatial skills; as such, the relationship between EF measures and “real life” behavior is critical.

Executive dysfunction (EdF) is a characteristic feature in a variety of clinical disorders in children (e.g., Barkley, 1998; Denckla, 1994, 1996a; Pennington & Ozonoff, 1996). Attention deficit hyperactivity disorder (ADHD) and Tourette syndrome (TS) have been of interest for investigators of EdF (Cirino, Chapieski, & Massman, 2000; Harris et al., 1995; Mahone, Koth, Cutting, Singer, & Denckla, 2001; Pennington & Ozonoff, 1996; Schuerholz, Baumgardner, Singer, Reiss, & Denckla, 1996) because both are presumed to be symptomatic of anomalous basal ganglia–thalamico-cortical loops that involve the prefrontal cortex (Baxter, Schwartz, Guze, Bergman, & Szuba, 1990; Denckla & Reiss, 1997), and poor performance on measures that involve novelty, planning, inhibition, organization, and other EF features is characteristic of individuals with damage to circuits that involve the prefrontal regions (Cummings, 1993; Levin et al., 1991; Lou, Anderson, Steinberg, McLaughlin, & Friberg, 1998; Lou, Henriksen, & Bruhn, 1984).

In studies of children and adults with ADHD, there is consistency in the presence of difficulties in sustained attention (Harris et al., 1995; Levy & Hobbes, 1997), and several investigators have found deficits in one or more areas of EF (Aman, Roberts, & Pennington, 1998; Grodzinsky & Diamond, 1992; Reader, Harris, Schuerholz, & Denckla, 1994). Mahone, Hagelthorn, et al. (1999) found significant differences between ADHD and controls on tests of variables of attention—visual (TOVA-V) commissions and response variability, but only for children with average IQ, contrasted to those with high average and/or superior IQ. Lovejoy et al. (1999) attempted to use measures of EF to predict diagnostic classification in ADHD, and found that, while rates of positive predictive power were high, false negatives were also common. This finding suggests that, although performance-based measures of EF may be

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