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Clock face drawing in children with attention-deficit/ hyperactivity disorder

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Abstract

The clock drawing test has been found to be sensitive to visual–spatial perception, graphomotor skills, verbal reasoning, and executive functioning in adult patient populations, as well as frontal lobe maturation in normal children. Our study is among the first to assess the use of clock drawing as a neuropsychological measure in the pediatric population. Participants included 41 children with attention-deficit/hyperactivity disorder (ADHD) and 41 normal controls, ages 6–12 years, matched for age, gender, and handedness. Conceptualization of time and construction of the clock face were assessed separately using a scoring system normed on school-age children in an earlier study. Children with Predominantly Inattentive Type were found to perform similarly to those with Combined Type of ADHD. However, children with ADHD, regardless of subtype, performed significantly poorer than controls. Qualitative analysis of performance revealed errors that were subsequent to poor planning during task execution, consistent with executive dysfunction commonly present in children with ADHD. Further, multiple regression analysis demonstrated that a neuropsychological measure of executive functioning was predictive of clock construction performance in children with ADHD. Constructional praxis and receptive vocabulary also were predictive of clock construction ability. Implications of these findings are discussed.

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1. Introduction

The clock drawing test routinely has been administered as a component of neuropsychological evaluations with adults (Goodglass & Kaplan, 1983; Strub & Black, 1977). Many investigators report clock drawing to be a measure of visuospatial skills and graphomotor abilities (Goodglass & Kaplan, 1983; Mendez, Ala, & Underwood, 1992; Sunderland et al., 1989), while others state that it also measures aspects of executive functioning (Libon, Malamut, Swenson, Sands, & Cloud, 1996; Royall, Cordes, & Polk, 1998). The clock drawing test requires minimal materials and typically takes less than 5 min to administer. While the simplicity of the task may suggest that it has only limited usefulness, the process utilized in constructing a clock, as well as the errors made, provides valuable information as part of a comprehensive evaluation (Freedman et al., 1994).

1.1. Clock face drawing in adults

Much has been published on the clock drawing task in the adult literature. For example, the clock drawing test has been found to be an effective means of predicting rate of cognitive decline (Rouleau, Salmon, & Butters, 1996) and of documenting dementia severity (Manos & Wu, 1994; Shulman, Gold, Cohen, & Zuccherro, 1993; Sunderland et al., 1989). It also has been used in the identification of unilateral spatial neglect (di Pellegrino, 1995; Heilman, Watson, & Valenstein, 1985; Mesulam, 1985). In earlier studies of this type, it was found that adult patients with unilateral neglect place all numbers on the right half of the clock face (Heilman et al., 1985; Mesulam, 1985). More recently, it has been demonstrated that verbal reasoning ability can be used to mediate completion of the task and to compensate for visuospatial neglect through the use of a planning strategy (e.g., placement of numbers 12, 3, 6, 9 in correct position prior to placement of other numbers; Ishiai, Sugishita, Ichikawa, Gono, & Watabiki, 1993).

Much of the adult literature has utilized a “command” version of the clock drawing task (i.e., instructing individuals to “draw a clock” without a model). This version taps language comprehension, along with visual–spatial retrieval and planning/execution; hence, it assesses the integrity of the left temporal lobe, the mesial–temporal regions and the frontal regions (Delis & Kaplan, 1983; Freedman et al., 1994). The clock drawing test also is seen as a measure of constructional praxis regardless of whether a command or copy version is used, assessing parietal functioning (Critchley, 1953; Freedman et al., 1994). In addition, the measure provides information about an individual’s knowledge of time by means of hand placement to the time specified by the examiner.

1.2. Development of clock face drawing in normal children

The extent to which clock drawing is a reflection of cognitive functioning in children has received limited attention in the literature. Edmonds, Cohen, Riccio, Bacon, and Hynd (1993) presented the first scoring system normed for use with children ages 6–12 years, which is now in press (Cohen, Riccio, Kibby, & Edmonds, 2000). This scoring system was based upon those published in the adult literature, along with the common error types made by various adult populations. Error types typically included deficits in the spatial arrangement of

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