Applied Neuropsychology: Child

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/hapc20

Contribution of Rating Scales to Intervention for Executive Dysfunction

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Published online: 21 Feb 2014.

To cite this article: Peter K. Isquith , Robert M. Roth , Lauren Kenworthy & Gerard Gioia (2014) Contribution of Rating Scales to Intervention for Executive Dysfunction, Applied Neuropsychology: Child, 3:3, 197-204, DOI: 10.1080/21622965.2013.870014
To link to this article: http://dx.doi.org/10.1080/21622965.2013.870014

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Executive dysfunction is present in children, adolescents, and adults with a wide range of clinical conditions. A growing body of literature has demonstrated the usefulness of rating scales designed to gauge executive functioning in everyday life. In this article, we discuss evidence supporting the use of such rating scales to assess intervention outcome, how they may inform development of interventions, and how comparing rater perspectives can assess awareness of cognitive dysfunction. We provide an example of how an executive function rating scale helped define intervention targets and measured outcomes in a recently published real-world intervention for children with autism spectrum disorder. Rating scales of executive function provide valuable information with respect to treatment planning and assessment of intervention outcome.

Key words: executive function, intervention, measurement

In a recent issue of this journal, we argued that several lines of evidence support the validity of using rating scales to measure executive function, including that rating scales reveal patterns of everyday executive functioning that are consistent with clinical expectations, that they correlate in the expected manner with biological markers, and that they show logical concurrent and predictive relationships with real-world functioning such as academic skills (Isquith, Roth, & Gioia, 2013). Many studies have reported that rating scales often correlate minimally or not at all with performance measures (i.e., “tests”) of executive function (e.g., Anderson, Anderson, Northam, Jacobs, & Mikiewicz, 2002; MacAllister et al., 2012; McAuley, Chen, Goos, Schachar, & Crosbie, 2010; Teunisse et al., 2012; Toplak, West, & Stanovich, 2013; Vriezen & Pigott, 2002) and that the two types of measures share less than 20% of variance at best (Barkley & Murphy, 2011). The lack of consistent relationships between measures suggests that they are measuring different aspects of executive function. Which aspects each method measures remains to be determined, but some suggest that performance measures tap specific components of executive function in isolation while rating scales assess application of those skills (Isquith et al., 2013) in an integrated, multidimensional, relativistic, priority-based decision-making process that is demanded in the real world (Goldberg & Podell, 2000). Regardless of how the types or levels of measurement are conceptualized, it has been increasingly argued that performance tests of executive function are no longer the “gold standard” of
executive function assessment (Barkley & Murphy, 2011) and that rating scales have begun to usurp that position. We continue to advocate, however, for a model of assessment that views the developing child within their environment, or the “child-world” model (Holmes-Bernstein & Waber, 1990), which incorporates at least two levels of assessment: specific components defined by performance measures and real-world behavioral manifestations assessed via rating scales.

As the goal of neuropsychological assessment has shifted increasingly from assessment for diagnostic purposes such as identifying brain injury or lesion location to identifying functional strengths and weaknesses and developing treatment goals and interventions (Lezak, 1995), the emphasis in assessment approaches has also shifted increasingly from the precision of laboratory-based measures removed from context to more ecologically valid measures in the real-world context of the individual being evaluated (Franzen & Wilhelm, 1996). When neuropsychological tests are used to quantify specific deficits, traditional validity (e.g., construct validity) is paramount and ecological validity may be of little concern. In practice, however, we are increasingly asked to not only identify functional strengths and weaknesses, but to translate such findings into implications, predictions, interventions, and accommodations for individuals in their everyday milieu. Particularly complex are the demands placed on pediatric neuropsychologists, who are asked what the child’s strengths and weaknesses are, along with questions about academic placement, interventions and accommodations, appropriate Individualized Education Program (IEP) goals, implications for home, school, and community functioning, and what future behavioral and emotional developments might be expected in the course of the child’s development (Silver, 2000). In this scenario, ecological validity considerations become paramount (Gioia & Isquith, 2004).

Although the past decade has seen substantial growth in research on executive function in children and adolescents (Anderson, Jacobs, & Anderson, 2008; Bernstein & Waber, 2007), only more recently has there been research on relationships between executive function and real-world functioning such as academic performance in children (Clark, Pritchard, & Woodward, 2010) and adolescents (Waber, Gerber, Turchios, Wagner, & Forbes, 2006) or occupational functioning in adults (Barkley & Murphy, 2011). Even more recently, research has turned to developing interventions for executive dysfunction and measuring outcomes in the real world. In this endeavor, rating scales of executive function are well suited to the task given their strong ecological validity, demonstrated ability to capture multiple perspectives at multiple time points, and time efficiency and cost-efficiency. In this article, we discuss how rating scales of executive function have contributed to the evaluation of intervention outcomes and have facilitated development of everyday real-world interventions. There are only a few executive function rating scales with a sufficient empirical literature base that has examined their use as intervention outcome measures, particularly the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000), the Frontal Systems Behavior Scale (Grace & Malloy, 2002), and the Dysexecutive Questionnaire (Wilson, Alderman, Burgess, Emslie, & Evans, 1996). We have focused our review on the BRIEF family of instruments given the burgeoning literature on intervention studies that rely on the measure and its focus on everyday interventions since its inception. Although we rely on the BRIEF as an exemplar, we believe that the same issues and arguments apply to other rating scales of executive function (Grace & Malloy, 2002).

FROM ASSESSMENT TO INTERVENTION

An assessment methodology that helps identify real-world executive function problems in the everyday context of the individual can help inform clinical practice in several ways. Executive function rating scales can serve as a valuable tool in assessing the outcome of interventions, can help to inform intervention strategies to maximize functioning, and can provide information with respect to awareness of cognitive deficit.

Intervention Outcome

Rating scales of executive function are playing an increasing role in assessing the outcome of a variety of interventions. For example, the BRIEF has been used to assess the effects of medications on executive functions in the everyday life of individuals with attention-deficit hyperactivity disorder (ADHD; Biederman et al., 2011; Dupaul et al., 2012; Findling, Ginsberg, Jain, & Gao, 2009; Maziaide et al., 2009; Turgay et al., 2010; Yang et al., 2011), Tourette syndrome (Cummings, Singer, Krieger, Miller, & Mahone, 2002), traumatic brain injury (TBI; Beers, Skold, Dixon, & Adelson, 2005), hepatitis C virus (Rodrigue et al., 2011), major depressive disorder (Roth et al., 2012), and hypertension (Lande et al., 2010). It has also been employed to examine outcomes following interventions such as liver transplantation (Sorensen et al., 2011), chemotherapy in breast cancer (Kesler, Kent, & O’Hara, 2011; McDonald, Conroy, Smith, West, & Saykin, 2013), corticosteroid treatment in children with inflammatory bowel disease (Mrakotsky et al., 2013), and family-based intervention in TBI (Wade, Wolfe, Brown, & Pestian, 2005; Wade, Wolfe, & Pestian, 2004). The BRIEF has also been used to evaluate the outcome of cognitive remediation approaches in ADHD (Beck, Hanson, Puffenberger, Benninger, & Benninger, 2010;
Hahn-Markowitz, Manor, & Maeir, 2011) and TBI (Toglia, Johnston, Goverover, & Dain, 2010). As the majority of studies have focused on ADHD and TBI, we provide an overview of those studies to further illustrate the use of executive function rating scales.

ADHD. The majority of studies using executive function rating scales as an outcome measure in ADHD have involved medication trials (Biederman et al., 2011; Dupaul et al., 2012; Findling et al., 2009; Mazia et al., 2009; Turgay et al., 2010; Yang et al., 2011). Two open-label studies of lisdexamphetamine dimesylate involving 278 (Findling et al., 2009) and 308 (Turgay et al., 2010) children diagnosed with ADHD, respectively, showed reductions in ADHD symptoms and substantial improvements in parent-rated executive functioning (Turgay et al., 2010), with the change in executive function correlating with improvements in ADHD ratings (Turgay et al., 2010). The Turgay et al. (2010) study further observed that all ADHD subtypes showed normalized executive function ratings following treatment. Mazia and colleagues (2009) compared test performance and parent ratings of 16 children diagnosed with ADHD and 20 typically developing children who completed baseline and 6-month follow-up assessments in an open-label study of atomoxetine. Performance on A Developmental Neuropsychological Assessment (NEPSY; Korkman, Kirk, & Kemp, 1998) showed no change from baseline to 6-month follow-up in the treatment group relative to the control group, but there were significant improvements in scores on a more ecologically oriented measure, the Test of Everyday Attention for Children (TEA-Ch; Manly et al., 2001). Parent and teacher ratings also showed significant improvement for the treatment group but not controls. In addition, a single-blind randomized study of 85 students receiving methylphenidate and 57 receiving atomoxetine revealed significant changes from baseline to posttreatment on several standard performance measures of executive function (e.g., Stroop, Trail-Making Test, Tower of Hanoi) and on both parent- and teacher-completed executive function rating scales (Yang et al., 2011).

Dupaul and colleagues (2012) evaluated the effectiveness of lisdexamphetamine dimesylate in 24 college students diagnosed with ADHD in a double-blind, placebo-controlled, crossover design. The students completed ratings of ADHD symptoms and the BRIEF-A (BRIEF Adult version) at baseline (unmedicated), after placebo, and again after small, medium, and high medication dose phases. There were significant reductions in ADHD symptoms and all executive function ratings except the Emotional Control and Self Monitor scales, with greater improvement observed as dosage increased. A total of 86% of participants reported significant reduction in ADHD symptoms with medication and 72% reported improved executive function. The authors concluded that despite significant reduction in ADHD symptoms with medication, students with ADHD continued to experience executive function difficulties and were not fully “normalized,” and thus, there is a need to develop effective psychosocial treatments as an adjunct to pharmacotherapy.

In a study of adults with ADHD, Biederman and colleagues (2011) completed a three-phase, double-blind, placebo-controlled parallel study of methylphenidate with 40 adults in the treatment group and 46 in the placebo group. All participants completed the BRIEF-Adult Self-Report along with a battery of performance-based academic, executive function, and other cognitive measures at baseline and again after 6 weeks. The authors defined “executive function deficit” (EFD) on the performance measures as having two or more scores below the 25th percentile and on the BRIEF-A as having two or more scales (more problematic) with a T score of 65 (i.e., above the 93rd percentile). While only 40% of participants with ADHD met criteria for an EFD based on performance measures, 93% met the criteria on the BRIEF-A. Notably, only 15% had working-memory performance test scores below the 25th percentile (lower percentile reflecting worse performance), while 95% had scores above the 93rd percentile on the BRIEF-A. Executive function ratings closely tracked improvement in ADHD symptoms, with 80% of treatment nonresponders remaining impaired on two or more scales but only 25% of responders remaining impaired. That the small subgroup of adults who responded well to medication with respect to ADHD symptoms continued to report problems with working memory, planning, and organization on the rating scale led the authors to concur with Dupaul et al. (2012) that even in the context of improvement in ADHD symptoms with medication, there may remain EFDs, and “considering the heterogeneity of the putative underlying mechanisms responsible for the development of EFDs, interventions aimed at improving EFDs need to be tailored to address them” (Biederman et al., 2011, p. 513).

A few studies to date have reported on the use of rating scales to measure change in executive function with nonmedication interventions in children with ADHD. Beck and colleagues (2010) evaluated the efficacy of a 5-week working-memory training program in 52 children. Parent ratings showed reduced problems with initiation, planning, organization, monitoring, and working memory at 4-month follow-up, while teacher ratings showed reduced problems with working memory and initiation. A study of a metacognitive strategy intervention that coached 14 children with ADHD and their parents in setting goals and planning how to achieve those goals showed significant improvements in parent and teacher ratings of executive function that were maintained at follow-up (Hahn-Markowitz et al., 2011). Finally, in a recent study, by Tamm and colleagues (2013) randomly
assigned 105 children diagnosed with ADHD to either 16 biweekly attention training sessions (Pay Attention!) or to a waitlist control group. Students in the training group performed better on the TEA-Ch and were rated by their parents as having significantly improved executive functions, while teacher ratings showed a trend toward improvement in ADHD symptoms. Liechti and colleagues (2012) provided neurofeedback to 13 children with ADHD during 36 sessions and observed significantly improved executive function per teacher, but not parent, ratings.

Traumatic brain injury. In a 12-week randomized clinical trial with 27 children with TBI (30% mild, 27% moderate, 43% severe), participants were randomly assigned to receive amantadine hydrochloride or to serve as controls (Beers et al., 2005). Although the two groups did not differ with respect to parent-rated executive functioning at baseline, the treatment group showed improvements on parent ratings and performance on a working-memory task (N-back) but not on other performance measures of executive function.

Several cognitive-behavioral, family-based intervention programs have shown amelioration in ratings of executive function among those with TBI. Chan and Fong (2011) reported that a metacognitive problem-solving skills-training program resulted in a significant improvement in parent ratings of their children’s executive function difficulties relative to both baseline ratings and to a control group. A study of 14 preadolescents with TBI versus a matched injured control group showed improvements in several aspects of executive functioning, as rated by parents, following an intervention program involving social mediation, cooperative learning, and metacognitive learning (Braga, Rossi, Moretto, da Silva, & Cole, 2012). Improved ratings of executive function in everyday life were also observed in studies of children with TBI and their families involving a Web-based problem-solving intervention (Wade et al., 2004, 2005).

In adults, Toglia and colleagues (2010) explored the efficacy of a multicontext, nine-session treatment program designed to promote strategy use across settings. Informants for four adults who were 3 to 5 years postinjury and who participated in the treatment program completed the BRIEF-Adult Informant Report immediately pretreatment and shortly following the treatment sessions. All individuals with TBI were rated as having clinically elevated problems on one or more scales pretreatment and as having improved by approximately 1 standard deviation following treatment.

Intervention Strategies

We developed the BRIEF originally not only to capture executive functioning in the real world, but also to help identify targets for intervention and to assist in developing real-world interventions (Gioia, Kenworthy, & Isquith, 2010). It seemed logical that if the purpose of assessment was to assist in treatment, then we should offer suggestions that flow from the assessment to the intervention context. For example, if a child was rated as having their greatest difficulties with inhibitory control, then that might serve as the primary focus of intervention and support, while if the greatest difficulties were seen in shifting set or adjusting to change, then this area might warrant the most effort. This can be extended and refined to assist in identifying and prioritizing treatment targets in context: If a child is rated as having greatest difficulty with adjusting to change in the school context but not at home, the interventions might be focused primarily within the school context. At the same time, observations of the child at home might reveal why she functions differently between settings and may offer ideas for how to intervene in the problematic setting.

The BRIEF has stood alone since its publication in 2000 as an instrument that offered not only assessment of everyday executive functioning but also offered potential interventions for identified problems. For this effort, a significant influence was the work of Mark Ylvisaker and Tim Feeney (Ylvisaker & Feeney, 1998), who argued that it was essential to identify the key executive control strengths and challenges in the home, school, work, or community contexts in developing context-sensitive, collaborative, real-world intervention programs. This served as an overarching framework within which specific interventions could be implemented along with language for inclusion in IEP and 504 documents (Gioia & Isquith, 2001). In developing interventions, we culled the extant literature on interventions for problems with each executive function domain measured by the BRIEF, including inhibitory control, adjusting to change, regulating emotions, social monitoring, task monitoring, initiating, planning, organizing, and holding information in working memory for sustained periods of time. It is important to note, however, that the interventions provided were intended to serve as a starting point for the development of an intervention program appropriate to the person’s needs and abilities.

Awareness

Rating scales of executive function can provide valuable information to inform intervention by evaluating an individual’s view of their own executive functions and the consistency of self-reported functioning with reports by knowledgeable informants (e.g., parent, teacher, or spouse) and scores on performance-based measures. For example, an adolescent who acknowledges difficulties with working memory, planning, and organization that are interfering with the ability to complete work efficiently might be more amenable and invested in treatment than
In the clinical trial of Unstuck and On Target!, elementary school children were matched for autism symptomatology, age, parent education, IQ, minority, and medication status and then were randomly assigned to either a widely used social skills intervention or the Unstuck executive function intervention, both contextually based programs delivered with equal intensity and
high fidelity in real-world home and school settings. Both interventions were associated with improvements from pretreatment to posttreatment on both performance measures and ratings on the BRIEF, even after controlling for IQ, age, gender, and parent education. Children in the explicit executive function intervention, Unstuck, exhibited significantly greater improvements in problem solving, flexibility, planning, and organization than did children in the social skills intervention program, while both groups of children showed equivalent measurement gains in social skills. Notably, there was an improvement of a full standard deviation or more on the BRIEF Shift scale following the Unstuck intervention.

**DISCUSSION**

As the focus of neuropsychology has broadened during the past few decades from diagnosis to developing interventions and identifying accommodations, assessment methodologies have necessarily begun a parallel broadening to include a greater emphasis on ecological validity, or assessing the everyday functioning of individuals in their real-world environments. To this end, rating scales play an important role in assessing emotional, personality, behavioral, and adaptive functioning. The late 1990s saw the application of rating scale methodology to the problem of assessing individuals’ executive functioning in the real-world context. A considerable body of literature supports the validity of these scales for measuring executive function, and some go as far as to suggest that performance measures are no longer the “gold standard” (Barkley & Murphy, 2011) as rating scales and performance measures correlate poorly (McAuley et al., 2010).

Rating scales of executive function offer some advantages for developing interventions and for measuring intervention outcomes. In guiding development of interventions at a programmatic level or on an individual level, rating scales help capture everyday functioning in the real-world context, an essential ingredient to developing successful interventions (Feeney & Ylvisaker, 2003). With specific functions in the real-world context targeted, rating scales then offer an inexpensive and efficient means of repeated measurement to help evaluate the effectiveness of interventions. In this article, we reviewed a set of intervention studies focused on individuals with either ADHD or TBI, as these constitute the largest current body of evidence though there are many other intervention studies that use executive function rating scales as outcome measures. These studies suggest that executive function rating scales are typically sensitive to change associated with intervention.

Although the constructs that rating scales and performance-based measures each tap remain to be clarified (Toplak et al., 2012), we advocate for a model of assessment that includes both types of measures (Isquith et al., 2013). The Unstuck and On Target! (Cannon, Kenworthy, Alexander, Werner, & Anthony, 2011) curriculum provides an example of how assessment of executive function, with rating scales and performance measures, guides intervention and, in turn, how those same measures are useful in measuring the effectiveness of interventions.

**REFERENCES**


at the 165th Annual Meeting of the American Psychiatric Association, Philadelphia, PA.


