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Incremental Validity of Neuropsychological Assessment in the Identification and Treatment of Youth with ADHD

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Abstract

Comprehensive neuropsychological assessments for youth with ADHD allow for thorough consideration of co-occurring disorders and provide targeted recommendations for treating ADHD and comorbid conditions. This study offers a preliminary evaluation of the added value (compared to routine care) associated with neuropsychological assessment in the identification and treatment of ADHD in youth ages 3-17 years. First, we describe a novel measure developed to evaluate broad-based outcomes for youth with ADHD following neuropsychological assessment. Next, we compare parent ratings of child symptoms and quality of life between two groups of youth with ADHD: those who have recently received neuropsychological assessments (NP+), and those who have *not* (NP−). Participants were surveyed again 5 months after baseline to assess changes in symptoms, quality of life, and service utilization. While both groups experienced significant improvements in behavioral/emotional symptoms, the NP+ group had greater initiation of parent behavior management training and special education services and greater initiation of medication management over the follow-up period, compared with the NP− group. Satisfaction with neuropsychological assessment was high overall but slightly decreased over the course of the follow-up period. The findings offer preliminary support for the incremental efficacy of neuropsychological evaluation in the diagnosis and management of ADHD.

Keywords

ADHD; neuropsychological; testing; quality of life; utility; efficacy; outcome

Introduction

The principles of evidence-based practice have increasingly been recognized by patients, clinicians and third-party payers as critical to the effective and efficient practice of health care (American Academy of Pediatrics, 2000; American Psychological Association, 2002; Levant & Hassan, 2008). Thus, it is now imperative that services be justified by a solid foundation of scientific research that speaks to their effectiveness. Despite abundant research into the causes of and treatments for Attention-deficit/Hyperactivity Disorder (ADHD), at this point research has not specifically addressed the impact (i.e., added value) of neuropsychological assessment on treatment, symptom reduction and quality of life in youth/families living with ADHD. The present study represents an initial step in directly assessing the impact of neuropsychological assessment in outcomes and intervention accessibility for children and adolescents with ADHD by: 1) examining change in child symptoms and child/family perception of quality of life following comprehensive neuropsychological assessment; and, 2) comparing the efficacy of symptom management

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and quality of life enhancement for youth with ADHD who *have* versus those who *have not* received comprehensive neuropsychological assessment in order to directly evaluate the incremental impact of the assessment process.

Why ADHD?

ADHD has been identified as a significant public health concern, given its prevalence and functional impact. The most recent prevalence estimates, reflecting the period from 2007 through 2009, suggest that as many as 8 to 9% of U.S. youth have ever been diagnosed with ADHD, and that the prevalence seems to have increased substantially over the past decade (Akinbami, Liu, Pastor, & Reuben, 2011; Bloom, Cohen, & Freeman, 2011; Getahun et al., 2013). These estimates suggest that childhood ADHD, while somewhat less prevalent than childhood anxiety disorders (affecting 15-20% of children and adolescents; Beesdo, Knappe, & Pine, 2009), is equal in prevalence to depression (9% among children and adolescents; Office of Applied Studies, 2005), and more than 8 times as prevalent than autism spectrum disorders (1% prevalence; CDC, 2008).

In addition to its prevalence, ADHD is notable for the level of functional impairment that it causes in youth and the wide variety of life domains that are impacted if youth are not appropriately diagnosed and treated. Those diagnosed with ADHD are much more likely to be diagnosed with a comorbid disorder or diagnosis, such as a learning disability, conduct disorder, anxiety, or depression (Larson, Russ, Kahn, & Halfon, 2011). They are also at risk for poor social skills and association with deviant peer groups, as well as difficulties with emotion regulation, frustration tolerance, self-esteem, and empathy (Wehmeier, Schacht, & Barkley, 2010). They experience poorer overall quality of life (Limbers, Ripperger-Suhler, Boutton, Ransom, & Varni, 2011) and are at increased risk for alcohol use disorders (Owens & Bergman, 2010), as well as involvement in the juvenile justice system (Bussing, Mason, Bell, Porter, & Garvan, 2010). Untreated youth with ADHD also create a larger cost to the US Education System, representing a 6-fold increase in cost as compared to students without an ADHD diagnosis, totaling 13 billion dollars annually (Robb et al., 2011). In addition to the psychological cost of ADHD, the disorder contributes to a significant financial burden for both individual families and society as a whole. Individuals with ADHD have more injuries and tend to visit the hospital and primary care physicians more frequently, incurring substantially greater medical costs over time than those without ADHD (Hakkaart-van Roijen et al., 2007; Leibson, Katusic, Barbaresi, Ransom, & O'Brien, 2001; Swensen et al., 2003). As adults, these risks result in a 33% reduced earning rate and a 15% increased use of social assistance among individuals with ADHD (Fletcher, 2013).

ADHD Diagnosis and Treatment

Given the individual and societal costs associated with ADHD, appropriate diagnosis of and treatment for the disorder are clearly critically important. Currently, more than half of youth with ADHD are diagnosed and treated within the primary care setting (Epstein et al., 2008; Leslie, Stallone, Weckerly, McDaniel, & Monn, 2006; Leslie, Weckerly, Plemmons, Landsverk, & Eastman, 2004). Although formal guidelines for the diagnosis of ADHD are available, adherence to these guidelines (i.e., DSM-IV criteria) has been generally poor among primary care providers due to limited training in their use and insufficient time during routine visits (see Pritchard, Nigro, Jacobson, and Mahone, 2011 for review). Formal guidelines based on the recently released 5th Edition of the Diagnostic and Statistical Manual of Mental Disorders (APA, 2013) are not yet available; however, it seems unlikely that substantial changes to these guidelines will be necessitated by the relatively minor revisions that were made to the diagnostic criteria for ADHD in this newest edition. Youth who do not receive an appropriate diagnosis and thorough diagnostic conceptualization including consideration of co-occurring symptoms and disorders, are unlikely to receive

appropriate treatment. Inappropriate or incomplete treatment is less effective in reducing core and co-occurring symptomatology. Stimulant medication, the treatment of choice for ADHD, though effective in *reducing* symptoms, does not fully *normalize* youth with ADHD's functioning or address co-occurring impairments (e.g., learning difficulties, social skill deficits, depression, anxiety; Biederman et al., 1999; Coghill, 2010; Danckaerts et al., 2010; Frazier et al., 2010; Gilberg et al., 2004; Loe & Feldman, 2007). Similarly, evidence-based behavioral treatments for ADHD have been shown to reduce both core and co-occurring symptoms, but do not normalize functioning and are not effective for all youth (Fabiano et al., 2009; Pelham & Fabiano, 2008; van der Oord et al., 2008). One explanation for these findings may involve inappropriate or incomplete diagnostic conceptualizations, which lead to the provision of inappropriate or incomplete interventions.

What can neuropsychological assessment contribute to the diagnosis and treatment of ADHD?

Due to their comprehensive nature, neuropsychological assessments are uniquely positioned to offer a thorough diagnostic conceptualization, as well as targeted recommendations for intervention for youth with ADHD. Mahone and Slomine (2008) operationalize a comprehensive child neuropsychological assessment as an evaluation of the following skills, as appropriate to the case at hand: general intelligence, academic achievement, executive functions, attention, memory, praxis as well as gross and fine motor skills, visual processing, language processing, adaptive skills, sensory and perceptual skills, and behavioral, emotional, and social functioning. They also specify that this evaluation is accomplished through the use of, in most cases, all of the following methods: history and clinical interview, a flexible battery of standardized instruments, observation, and behavior/skill ratings completed by the child (as appropriate), parents, and teachers. As such, the neuropsychological assessment is particularly well suited to the identification of ADHD, as it allows for evaluation of DSM criteria using multiple methods *and* provides thorough consideration of differential diagnoses. The latter is especially important given that many symptoms of ADHD are common to other childhood disorders (American Psychiatric Association, 2013) and because ADHD often co-occurs with other mental health conditions in childhood and adolescence. Data collected by the National Center for Health Statistics indicate that for children and adolescents with ADHD, the risk of an anxiety disorder is 7.45 times greater than for those without an ADHD diagnosis, the risk of depression is 8.04 times greater, the risk of an autism spectrum disorder is 8.72 times greater, and the risk of Tourette syndrome is 10.70 times greater (Larson et al., 2011).

The aims of this study are twofold: first, we offer information on the design and initial validation of a novel measure of outcomes associated with ADHD; second, we provide a preliminary evaluation of the added value of neuropsychological assessment for youth with ADHD. Because it provides a more thorough consideration of co-occurring disorders, individualized information regarding a child's strengths and weaknesses, and more diverse and targeted recommendations, we hypothesize that neuropsychological assessment can offer added value to the identification and treatment of childhood ADHD beyond identification and treatment 'as usual' (i.e., within the primary care setting). Specifically, at baseline, we expect that there will be no group differences in critical outcome variables (symptoms, quality of life, utilization of services). Our central hypothesis is that a reduction in symptomatology and an increase in quality of life will be evident over the course of the 5-month follow-up period among the group of youth who received neuropsychological assessments, but less improvement over time will be observed among those youth who did not receive these assessments. Thus, at follow-up, we believe that the youth who received neuropsychological assessment will be associated with better symptom management and better quality of life, as reported by parents.

Methods

Participants

Participants in the present study included 188 caregivers of children and adolescents diagnosed with ADHD. ADHD diagnostic status was based on parental endorsement of the following question: “Has your child ever been diagnosed with Attention Deficit/ Hyperactivity Disorder (ADHD) or Attention Deficit Disorder (ADD) by a professional such as a psychologist, pediatrician, psychiatrist, neurologist, family practitioner, general practitioner, or other type of physician?” Additionally, for children and adolescents who underwent a neuropsychological assessment, ADHD diagnostic status was confirmed by the neuropsychologist performing the assessment. All participants fell into one of two naturally occurring groups: caregivers of youth with ADHD who received neuropsychological assessments (NP+ group) and caregivers of youth with ADHD who had not (NP− group). The NP− group was required to have never had a neuropsychological assessment. Both groups completed the *Outcomes of Neuropsychological Assessment of ADHD* (ONAA) questionnaire (described below) at two time points in order to allow for between group comparisons of change in symptoms, functioning, and quality of life over time.

Procedure

Participants were recruited for the present study in several ways (see Figure 1). Youth in the NP+ group were identified for recruitment by their neuropsychologist. The majority of youth in this group (69%) were recruited from a large neuropsychological outpatient clinic in a Mid-Atlantic hospital, with the remainder being recruited from the practices of 14 other ABCN board-certified neuropsychologists located in Maryland, California, Massachusetts, Colorado, Wisconsin, New York, Texas, and Washington, DC. Participants in the NP+ group were recruited immediately following the feedback session for their child’s neuropsychological assessment. Participants were recruited for the NP− group via online advertisements (www.CHADD.org) and flyers distributed to pediatricians’ offices in the same cities used for recruiting participants in the NP+ group. At recruitment, parents in both groups were given a link to the secure online survey (described below). Participants’ initial completion of the survey represents the baseline time point, which fell within several days after the neuropsychological feedback session for the NP+ group and at the parent’s convenience after recruitment for the NP− group. Participants were then contacted approximately 5 months after their baseline survey to complete the follow-up. A 5-month interval was chosen in order to allow participants and families sufficient time to initiate treatment, should they choose to, and begin to see treatment gains. The baseline survey was completed, on average, in 13 minutes, with the follow up survey’s average completion time at 12 minutes. Parents were mailed a $5.00 gift card after completion of each questionnaire.

Development and Structure of the Outcomes of Neuropsychological Assessment of ADHD (ONAA) Questionnaire—The ONAA questionnaire was developed with the goal of providing a broad-based parent-report measure of satisfaction with the neuropsychological assessment process and assessment of multiple domains of functioning for youth with ADHD. The measure was designed to be sensitive to changes in symptoms, functioning, and satisfaction over time. Existing measures of ADHD symptoms, treatment services accessed, quality of life, and patient satisfaction, as well as social, emotional, academic, and family functioning were reviewed. To accomplish the goal of developing a broad-based measure, items were adapted from existing measures, and also generated by the study authors. In all, four versions of the ONAA questionnaire were constructed: a baseline and follow-up version for parents of youth who *did not* receive a neuropsychological assessment and a baseline and follow-up version for parents of youth who *did* receive neuropsychological assessment. The most comprehensive version of the

ONAA questionnaire (i.e., the follow-up for youth who did receive a neuropsychological assessment) is presented in Appendix A. Some items present in this version of the ONAA are only applicable in the context of a follow-up questionnaire or are only applicable for youth who received a neuropsychological assessment. Those items that are not applicable are not included in the baseline version of the questionnaire or the version of the survey given to the parents of youth who did not receive an assessment, as appropriate. Table 1 offers a list of existing measures from which items were adapted during development of the present measure.

The most comprehensive version of the ONAA questionnaire consisted of 58 questions: 13 dichotomous (yes/no) items, 39 items for which responses are given on a 5-point Likert scale, 1 item with a multiple choice format, and 5 open-ended items. The shortest version of the questionnaire (i.e., the baseline for youth who did not receive a neuropsychological assessment) consisted of only 48 items. On all versions of the questionnaire, items were grouped according to conceptual domain (e.g., family functioning, social functioning, functioning in school, services accessed). Development of subscales for the Likert-response items was also based on conceptual similarities. For the purposes of subscale development, items 39, 40, and 44 were reverse coded so that the valence of all items falling on any subscale was consistent. Scores on the following groups of items were then averaged to create mean subscale scores: *Satisfaction* (items 2-9); *Behavioral/Emotional Symptoms* (items 17-30); *Social Difficulties* (items 37-43); and *Family Difficulties* (items 44-52). Of note, items 1 and 10, both of which are related to satisfaction with the neuropsychological assessment, were not included on the Satisfaction subscale due to their dichotomous response formats. For the Behavioral/Emotional Symptoms, Social Difficulties, and Family Difficulties subscales, higher scores indicate greater dysfunction; however, for the Satisfaction subscale, higher scores indicate greater satisfaction with or a more positive impact of the neuropsychological assessment process. Table 2 presents inter-item reliabilities for the four subscales at both baseline and follow-up time points. At both time points, reliability for all subscales fell within the acceptable range.

In addition to these subscales, the ONAA questionnaire included items related to functioning in the school setting and items related to treatments/services accessed. School-related items included average report card grades, truancy, disciplinary actions (e.g., detention, suspension), and grade retention. Treatment- and service access-related items included participation in individual therapy or case management, family therapy, medication management, parent behavior management training, and hospitalizations. Because the items within each of these domains are variable in terms of both their response formats and their conceptual relatedness to one another, they were not combined to form domain subscales but were evaluated independently.

Analyses—Analyses focused on comparing the survey results for the group that did receive neuropsychological assessments (NP+ group) with those who did not (NP− group) at both baseline (Time 1) and follow-up (Time 2), and on evaluating change in symptomatology, services accessed, and multiple functional domains for each group over time. At baseline, between-group differences were evaluated via χ^2 statistics for dichotomous items (see Table 3) and via t-test for the three continuous subscales. Additionally, descriptive statistics are presented for use in evaluation of the patient satisfaction ratings, as these pertain only to the NP+ group (see Table 5). Consistent with the baseline analyses, between-group differences at follow-up were evaluated via χ^2 statistics for dichotomous items (see Table 3) and via t-test for the three continuous subscales, and descriptive statistics were used to evaluate the patient satisfaction ratings for the NP+ group (see Table 5).

The degree of change between baseline and follow-up in terms of symptoms, social-emotional and school functioning, and assessment satisfaction is most central to our hypotheses about the impact of neuropsychological assessment for youth with ADHD. The degree, and significance, of change between baseline and follow-up was evaluated using McNemar tests for dichotomous items (see Table 3) and repeated measures ANOVAs with follow-up RMANOVAs for the continuous subscale variables (see Table 4).

Results

Sample Characteristics

At baseline, the students rated in the sample had mean age of 9.60 years (SD = 2.94 years, range = 3.66 to 16.94 years), while average age at follow-up increased to 10.12 years (SD = 2.85, range = 4.59 to 17.12 years). No significant differences in age were found between youth in each group (i.e., NP+ group vs. NP− group) at either time point, $t(185) = 0.481$, $p = .631$, Cohen's $d = .071$ for baseline; $t(117) = 0.287$, $p = .775$, $d = .053$ for follow-up. The majority of the sample was male (73.94% at baseline, 73.11% at follow-up), with no significant differences in sex distribution between groups at baseline ($\chi^2(1) = 1.384$, $p = .239$, Cramer's V = .086), or follow-up ($\chi^2(1) = 3.27$, $p = .070$, Cramer's V = .166). In terms of the relationship of the individual completing the questionnaire to the child being rated, the ONAA questionnaire was completed, at both time points, in large majority by mothers (90.43% at baseline, 90.76% at follow up). The remainder of the questionnaires were completed by fathers, grandparents, and adoptive parents in approximately equal measure. The association between group membership and caregiver's relationship to the child was not statistically significant at baseline ($\chi^2(4) = 7.805$, $p = .099$, Cramer's V = .204) or follow-up ($\chi^2(4) = 8.771$, $p = .067$, Cramer's V = .272).

Group Comparisons on ONAA Questionnaire

Baseline (Time 1) Analyses—The baseline time point reflects parents' first completion of the ONAA questionnaire, which occurred shortly after the neuropsychological feedback session, at the parent's convenience, for the NP+ group. For the NP− group, baseline questionnaire completion did not coincide with any particular assessment- or treatment-related events. All participants who completed the baseline questionnaire (n = 188) were included in the baseline analyses described below. These analyses were also completed using only the participants who completed both the baseline and follow-up questionnaires (n = 119). The pattern of findings remained the same across both sets of analyses, with one exception, which is noted below. The statistics associated with the set of analyses, including all participants who completed the baseline questionnaire, are reported below.

School-related variables: At baseline, no significant group differences were observed in school-related variables, which included average report card grades, truancy, disciplinary actions (e.g., detention, suspension), and grade retention (see Table 3).

Treatment-related variables: Significantly more of the NP+ group (31%) than the NP− group (17%) participated in family therapy at baseline ($\chi^2(1) = 4.823$, $p = .028$, Cramer's V = .160). When only the participants who completed *both* baseline and follow-up questionnaires were used, this contrast was not statistically significant ($\chi^2(1) = 1.953$, $p = .162$, Cramer's V = .128); however, the pattern of greater participation in family therapy among the NP+ group (30%) than the NP− group (18%) remained. In contrast, at baseline, significantly more participants in the NP− group (81%) than in the NP+ group (46%) were treated with medication ($\chi^2(1) = 23.398$, $p < .001$, Cramer's V = .352).

Behavioral and social-emotional variables: No significant baseline group differences were observed on the Behavioral/Emotional Symptoms, Social Difficulties, or Family Difficulties subscales.

Satisfaction variables: At baseline the NP+ group reported high satisfaction overall with the neuropsychological assessment. Satisfaction items were rated on a Likert scale of 1 (not at all) to 5 (very much). All items received average ratings of at least 3.6 (somewhat), with three of the four items receiving mean ratings of 4 (quite a bit) or above, indicating that the neuropsychological assessment process was perceived as quite helpful by parents of youth with ADHD. Because the NP− group did not participate in the neuropsychological assessment process, they were not administered the items on the *Satisfaction* subscale.

Follow-up (Time 2) Analyses

The follow-up time point reflects parents' second completion of the ONAA questionnaire, which occurred, on average, 5.25 months after their first completion of the measure. The length of the interval between baseline and follow-up questionnaire completion did not differ by group ($t(117) = -0.560$, $p = .577$, $d = .104$). Because some participants in each group were lost to attrition, the following follow-up findings are based on comparisons between smaller groups. At baseline, 53 participants in the NP+ group were compared to 135 participants in the NP− group, while at follow-up 37 participants in the NP+ group were compared to 82 participants in the NP− group. Thus, the percentage of participants lost to attrition was 30% for the NP+ group and 39% for the NP− group. In the sample as a whole, participants who were lost to follow-up were significantly more likely to have received a disciplinary action in school at baseline ($\chi^2(1) = 6.004$, $p = .014$, Cramer's V = .180). No differences related to attrition were found on treatment-related or social-emotional variables. Within the NP+ group specifically, those who were lost to follow-up were rated as having greater social difficulties than those participants who completed both study time points ($t(51) = -2.257$, $p = .028$, $d = .632$). No such difference on this variable was observed within the NP− group. Additionally, it appears that the NP− group was driving the findings in the full sample regarding the relation between attrition and disciplinary actions, with a greater proportion of the individuals in this group who were lost to follow-up having received disciplinary actions at school than those who completed both surveys ($\chi^2(1) = 6.648$, $p = .010$, Cramer's V = .224). No significant relation between attrition and school disciplinary actions was observed within the NP+ group ($\chi^2(1) = 0.051$, $p = .822$, Cramer's V = .031). .

School-related variables—At follow-up, no significant group differences were observed in school-related variables (see Table 3).

Treatment-related variables—At follow-up, no significant group differences were observed in the prevalence of participation in behavioral treatments or medication management of ADHD symptoms (see Table 3).

Behavioral and social-emotional variables—No significant group differences were observed at follow-up on the Behavioral/Emotional Symptoms or Family Difficulties subscales. In contrast, at follow-up the NP+ group was rated as showing significantly less dysfunction on the Social Difficulties subscale than was the NP− group ($t(112) = 2.205$, $p = .030$, $d = .417$).

Satisfaction variables—At follow-up approximately 5 months after the neuropsychological assessment, the NP+ group still reported high satisfaction overall with the neuropsychological assessment: all of the follow-up satisfaction items received average ratings of least 3 (somewhat), with five of the eight items receiving mean ratings of 4 (quite

a bit) or above. These ratings suggest that, at follow up, the neuropsychological assessment process was still perceived as being helpful by parents of youth with ADHD.

Baseline – Follow-up Change Analyses

School-related variables—No significant differences in change over time were found between the NP+ group and the NP− group on measures of truancy, grade retention, or disciplinary actions. A repeated measures ANOVA using average report card grades as the dependent variable indicated no main effect of group membership, but a significant main effect of time ($F(1) = 4.11$, $p = .045$, $\eta_p^2 = .034$), with grades increasing between baseline and follow-up across both groups (see Table 4). No group-by-time interaction was observed for this variable; however, a significantly greater proportion of the NP+ group (22%) was identified for special education services in the interval between baseline and follow-up, as compared with 11% of the NP− group ($\chi^2(1) = 5.132$, $p = .023$, Cramer's V = .148). The majority of parents (71%) reported that this change in educational placement was primarily related to the educationally disabling effects of their child's ADHD.

Treatment-related variables—There were significant group differences in the degree of change over time for participation in parent behavior management training, individual therapy, and medication management of ADHD symptoms. A total of 20% of the NP+ group began parent behavior management training during the period between baseline and follow-up while only 3% of the group dropped it during that time (McNemar's $\chi^2(1) = 4.50$, $p = .034$). In contrast, there was no significant change over time in receipt of parent behavior management training among the NP− group (McNemar's $\chi^2(1) = 0.80$, $p = 0.371$). Among the NP+ group, 20% of participants began receiving individual therapy for ADHD between baseline and follow-up, while only 3% dropped it (McNemar's $\chi^2(1) = 4.50$, $p = .034$). Similarly, 16% of the NP− group began individual therapy between baseline and follow-up, while 4% dropped it (McNemar's $\chi^2(1) = 6.25$, $p = 0.012$). Finally, 40% of the NP+ group started medication treatment between baseline and follow-up, with no members of that group discontinuing medication during that time (McNemar's $\chi^2(1) = 14.00$, $p < .001$). Among the NP− group, only 11% started medication treatment between baseline and follow-up, while 1% discontinued medication for ADHD during that time (McNemar's $\chi^2(1) = 6.40$, $p = .011$).

Behavioral and social-emotional variables—In terms of change in behavioral and emotional symptoms, a repeated measures ANOVA yielded a significant main effect of time ($F(1) = 24.38$, $p < .000$, $\eta_p^2 = .179$), such that across groups, there was a significant reduction in behavioral and emotional symptoms between the baseline and follow-up time points (see Table 4). The main effects for group and the group-by-time interaction were not significant for the behavioral and emotional symptoms variable. Similarly, in terms of social difficulties, a repeated measures ANOVA yielded a significant main effect of time ($F(1) = 7.58$, $p = .007$, $\eta_p^2 = .063$), such that across groups, there was a significant reduction in social difficulties between the baseline and follow-up time points (see Table 4). Main effects of group and the group-by-time interaction were not significant for the social difficulties variable. No main or interaction effects were found for the family difficulties variable.

Satisfaction variables—Among the group of participants whose children received a neuropsychological assessment, 94% reported, approximately 5 months after the feedback session, that they felt that the evaluation was worth the time, effort, and expense ($n = 35$). Despite this observation, overall satisfaction with the neuropsychological evaluation fell from mean rating on a 5-point Likert scale of 4.21 (SD = .75) at baseline to mean rating of 3.87 (SD = .61) 5 months later ($t(35) = 2.51$, $p = .017$, $d = .497$).

Discussion

The present study is among the first to directly evaluate the added value of neuropsychological assessment among youth with ADHD. Overall, our findings provide preliminary evidence that youth with ADHD who receive neuropsychological evaluation are more likely to subsequently begin receiving both behaviorally-based treatment services and medication management, in comparison to youth with ADHD who are not evaluated by a neuropsychologist. Additionally, parental satisfaction with the neuropsychological assessment was quite high at both time points; however, it did decline slightly over the five months post assessment. Though preliminary, these findings suggest that receipt of a neuropsychological evaluation is associated with initiation of interventions that have been demonstrated to be effective in the treatment of ADHD (Jensen et al., 2007), and such interventions can result in both symptom reduction and improvements in quality of life (Danckaerts et al., 2010).

Utility of the ONAA Questionnaire

To our knowledge, the ONAA questionnaire is the first measure developed to provide a broad-based parent-report of outcomes for youth with ADHD following NP assessment. Because neuropsychological assessment is typically designed to offer a comprehensive view of a child's functioning, the ONAA was developed to capture multiple domains of interest that might be impacted by assessment. In addition to evaluating ADHD symptoms themselves, the measure quantifies the child's behavioral, emotional, social, family, and academic functioning, as well as his or her service use and quality of life. The ONAA also captures satisfaction with the assessment process and product, offering important information for quality assurance purposes. Other advantages of the ONAA include that the measure is quick to complete, taking less than 15 minutes, on average, and that online administration has proven successful. Results of the present study indicate that the measure is sensitive to change over time and offer preliminary evidence of the ONAA's psychometric soundness, with good inter-item reliability for all subscales.

Symptomatology, Service Use, and Quality of Life

In addition to establishing the utility of this new measure, this study aimed to evaluate the added value of neuropsychological assessment in the identification and treatment of ADHD by comparing youth who received neuropsychological assessment for ADHD with those who did not. At baseline, the NP+ and NP− groups were comparable in terms of academic, behavioral, social, and emotional functioning. Thus, it appears that youth with ADHD who are seen for comprehensive neuropsychological assessment do not necessarily manifest more severe or complex symptomatology, as rated by their parents, than youth with ADHD who are not assessed. Limited baseline differences between the two groups *were* evident in service use, with youth in the NP− group being more likely to be prescribed medication for ADHD than those in the NP+ group, who were more likely to be participating in family therapy. Taken together, these findings raise the possibility that families who eventually seek out neuropsychological assessment may be more inclined to use behaviorally-based treatments and/or more wary of medication treatment for ADHD than families who do not present for assessment. These findings also reinforce previous research, discussed earlier, suggesting that neither medication management nor behavioral treatments alone are sufficient to normalize symptoms of ADHD.

At follow-up, no significant differences were evident between the NP+ and NP− groups on indices of academic, behavioral, and emotional functioning, or in terms of service use; however, the NP+ group evidenced better functioning in the social realm than the NP− group at this time point. This unique improvement in social functioning may be related to

the comprehensive consideration of multiple domains of a child's functioning during neuropsychological assessments. Due to the prominence of their behavioral and academic difficulties, these areas may be the primary focus of intervention for many children with ADHD. As a result, although social difficulties are common among these children as well, problems with peer relationships may be neglected. The comprehensive nature of the neuropsychological assessment and associated recommendations may allow for consideration of this otherwise overlooked domain, which, in turn, may lead to improvement. This finding should be interpreted with caution, however, as it may be, in part, attributable to attrition effects. Those participants who were lost to follow-up in the NP + group had higher rates of social difficulties than those participants in the NP+ group who completed both time points.

Most central to the present study is the comparison of baseline and follow-up functioning across the two groups, which evaluate group-specific change over time. These analyses demonstrated a significant reduction in behavioral and emotional symptoms and social difficulties, as well as improvement in average grades within both groups over the 5-month follow-up period. The average grade improvement over time found in the present study may be, in part, attributable to attrition effects, given that those participants who were lost to follow-up were more likely to have received a disciplinary action at school, thus potentially limiting their availability for learning in the classroom, than those participants who completed the ONAA survey at both time points. The significant reduction in behavioral and emotional symptomatology and social difficulties, as well as the average grade improvement demonstrated across both groups, may reflect the impact at follow-up of treatments (both psychopharmacological and behavioral) that both groups had already begun receiving at baseline.

The most striking findings regarding the added value of neuropsychological assessment for youth with ADHD are evident in the service use domain. At school, special education services were *initiated* between baseline and follow-up for significantly more youth in the NP+ group than the NP− group. This finding is likely the result of the clear documentation of the functional disability associated with ADHD and its comorbidities, the documentation of present function and school-related needs, and recommendations for interventions and accommodations specifically targeted to the school setting that are provided by the neuropsychological assessment. An increase in school-related services designed to improve academic functioning, may, as a result, also impact the student's self-esteem and quality of life. Thus the increased initiation of academic interventions and accommodations seen in the NP+ group could have long-term effects in multiple domains of functioning for these students. At home, a significant increase in the use of parent behavior management training during the follow up period was observed for the NP+ group uniquely. This increase may be attributable to treatment recommendations made within the context of the neuropsychological assessment. This pattern of findings highlights neuropsychologists' commitment to evidence-based practice, as parent behavior management training has been repeatedly demonstrated as an effective intervention strategy for ADHD (Pelham & Fabiano, 2008; Fabiano et al., 2009). Both groups reported significant increases in the use of individual therapy during the follow-up period. Notably, parents are not asked to specify the nature of the individual therapy in the ONAA questionnaire, so it is not possible to know whether this increase represents initiation of effective, behaviorally-based therapeutic interventions, or play or talk therapies, which have not been demonstrated to be effective in the treatment of ADHD (Antshel & Barkley, 2008), or whether there were differences in the type of individual therapy initiated between the two groups. Medication management is another evidence-based and commonly utilized treatment for ADHD (Jensen et al., 2007). Although both groups in the present sample reported an increase in medication management of ADHD symptoms during the follow-up period, the NP+ group showed a much larger

increase in the use of this treatment than did the NP− group. Together, these findings suggest that, although neuropsychological assessment is not associated with unique improvement in all domains of functioning, it does seem to be particularly useful in encouraging parents to initiate evidence-based treatments for their children. The use of these types of effective treatments is associated with both symptom reduction and improved quality of life (Danckaerts et al., 2010).

Satisfaction with Neuropsychological Assessment

Among those who received neuropsychological assessment, short-term satisfaction with the assessment process and product was very high. Shortly after receiving feedback on the assessment, parents rated the majority of the satisfaction items a 4 out of 5, on average, indicating that the process was quite helpful to them. However, over the course of the 5-month follow-up period, overall satisfaction with the neuropsychological assessment fell by an average of 0.34 points on the 5-point Likert scale. Despite its statistical significance, the practical significance of a change of less than one Likert scale point is debatable. Parents remained generally satisfied with the assessment at follow-up, with the majority of the satisfaction items receiving average ratings of at least 3 out of 5 at follow-up, and more than half receiving average ratings of 4. In addition, the overwhelming majority (94%) of parents in the NP+ group reported feeling that the neuropsychological assessment was worth the time, effort, and expense.

Limitations and Future Directions

Due to the developmental nature of ADHD and the differences inherent in neuropsychological assessment of adults versus children and adolescents, the findings of the present study may not be generalizable beyond school-aged youth with ADHD. Future research in this area should consider a broader age range of individuals with ADHD and should evaluate further the potential moderating effect of learning disabilities on the relationship between neuropsychological assessment and outcomes. Clarification of the particular components of the neuropsychological assessment that contribute to its impact on patient symptomatology and quality of life will also be a critical future direction in order to further streamline the assessment process.

Another limitation of the present study is the fact that information regarding age at initial diagnosis of ADHD and duration of treatments at the time of the baseline questionnaire was not available for either group; therefore, we were unable to compare the two groups at baseline on those important variables. Differences in age at diagnosis and duration of pre-existing treatment between the two groups could contribute to differential progress in treatment over the follow-up period. These potential moderating variables should also be evaluated in future research.

In the present study, although ADHD diagnostic status was confirmed by assessment data for the NP+ group, it was based on parent report alone for the NP− group, thus we cannot be certain of diagnostic accuracy within that group. Additionally, given the parent-report nature of the study and the limited sample size, it was not possible to adequately investigate whether our findings vary according to ADHD subtype. Research suggesting that the Predominantly Inattentive Type of ADHD may be underdiagnosed, particularly among girls (e.g., Wolraich et al., 1998), raises the possibility that more thorough diagnostic conceptualization, such as that provided within the context of a neuropsychological assessment, could be particularly beneficial for certain subgroups of youth with ADHD, and this is a possibility that deserves further research attention. Finally, satisfaction with the process and outcomes of ADHD diagnosis and treatment was assessed among the NP+ group only in the present study. Although parents in the NP+ group reported high

satisfaction overall with the process and product of the assessment at both time points, this satisfaction may, in part, represent a confirmatory bias. That is, those parents who chose to have their children evaluated by a neuropsychologist likely did so because they believed, even before the assessment, that neuropsychological evaluation is a useful tool in the diagnosis and management of ADHD. Measurement of satisfaction with diagnosis and treatment among families whose children have not been assessed would provide a useful basis for comparison. Of note, the findings regarding change in satisfaction over time among the NP+ group mitigate the possibility of confirmatory bias.

Future research in the area of neuropsychological assessment for ADHD also might examine the provider-level variables that could moderate the effectiveness of the assessment process and product. In particular, the present study suggests a decrease in satisfaction with the assessment over the follow-up period. Future research should explore what underlies this decrease – for instance, would an increase in contact between the neuropsychologist and the family (e.g., progress monitoring, troubleshooting implementation of recommendations) during the follow-up period result in maintenance of or even increase in satisfaction ratings? Would an increase in post-assessment contact result in reduction of symptoms or improved quality of life for individuals with ADHD and their families?

The present study represents a first step in establishing the value added by neuropsychological assessment. With further research, neuropsychological assessment may one day reach the status of an evidence-based intervention for ADHD.

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Table 1

Measures From Which Items for the ONAA Were Adapted

Measure Name
ADHD Impact Module-Child (AIM-C; Landgraf, Rich, & Rappaport, 2002)
Assessment Impact Questionnaire (Farmer & Brazeal, 1998)
Child Health Questionnaire (CHQ; Landgraf, Abetz, & Ware, 1996)
Client Satisfaction Questionnaire (Larsen, Attkisson, Hargreaves, & Nguyen, 1979)
Interactive Autism Network Survey (www.ianresearch.org)
Services for Children and Adolescents-Parent Interview (SCA-PI; Jensen et al., 2004)
Swanson, Nolan & Pelham-IV (SNAP-IV; Swanson, 1992)

Table 2

Inter-Item Reliabilities for the Conceptually-Based Subscales

Subscale	Baseline α (n = 188)	Follow-up α (n = 119)
Emotional/behavioral	.832	.824
Social	.874	.880
Family	.866	.884
Satisfaction*	.770	.808

*Satisfaction subscale applies to the neuropsychological assessment group only, so the baseline α n for this subscale = 54 and the follow-up α n for this subscale = 36. The satisfaction subscale also adds 4 items at follow-up.

Table 3

Comparison of Groups on Dichotomous Variables

	NP+ group		NP- Group	
	Baseline (% endorsed)	**Follow-up (% endorsed)**	**Baseline (% endorsed)**	**Follow-up (% endorsed)**
Truancy	0.00	0.00	3.66	3.70
Medication for ADHD	43.24	80.00*	81.71	91.14*
Worked to potential	40.54	52.78	36.59	41.98
Family Therapy	29.73	31.43	18.29	20.25
Individual Therapy (child)	37.84	57.14*	28.05	40.51*
Parent Training	16.22	34.29*	26.83	31.65
School disciplinary action	16.22	11.11	15.85	9.88
Retained in school	2.70	2.78	8.54	8.64
Hospitalization	5.41	5.71	1.22	2.53

Note. The % endorsed at Baseline for each group that is presented here is calculated using data from only those participants who completed both the Baseline and Follow-up surveys. 'NP+ group' refers to the group of participants who received a neuropsychological assessment, while 'NP- group' refers to the group of participants who did not.

* indicates significant ($p < .05$) within-group difference in proportion of sample endorsing item between baseline and follow-up

Table 4

Repeated Measures ANOVAs: Main Effect of Time

	Baseline Mean (SD)	Follow-up Mean (SD)
Behavioral/Emotional Symptoms	2.642 (.655)	2.403 (.578)*
Social Difficulties	2.724 (.965)	2.530 (.962)*
Family Difficulties	2.210 (.887)	2.098 (.888)
Average Grades	3.590 (1.855)	3.145 (1.604)*

Note. Ratings ranged from 1 (not at all) to 5 (very much) for the Social Difficulties and Family Difficulties scales, from 1 (never) to 5 (almost always) for the Behavioral/Emotional Symptoms scale, and from 1 (mostly A's) to 9 (mostly F's) on the average grades scale. For all scales except Average Grades a higher rating indicates that more concerns were endorsed.

*Indicates a significant main effect of time on repeated measures ANOVA

Table 5

Neuropsychological Assessment Satisfaction Ratings

Item	Baseline Mean (SD)	Follow-up Mean (SD)
Do you understand your child's cognitive and/or behavioral issues better?	4.33 (0.80)	4.06 (0.79)*
Do you understand your child's strengths better?	4.06 (1.09)	4.00 (0.72)*
Did the assessment help you to feel less stressed regarding your child's difficulties?	3.63 (1.19)	3.31 (1.14)
How helpful was the feedback session?	4.31 (1.08)	4.22 (0.83)
Have the results been useful in regards to their education or any treatment that they receive?	-	4.14 (0.87)
How much improvement in your child's symptoms or functioning have you seen?	-	3.00 (1.15)
Were the recommendations helpful?	-	3.83 (1.13)
How helpful was the written report?	-	4.39 (0.77)

Note. Ratings ranged from 1 (not at all) to 5 (very much). The last four items were only administered at follow-up.