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What is This?

Susan W White, Laura A Smith and Amie R Schry

Abstract
Assessment of global functioning is an important consideration in treatment outcome research; yet, there is little guidance on its evidence-based assessment for children with autism spectrum disorders. This study investigated the utility and validity of clinician-rated global functioning using the Developmental Disability–Child Global Assessment Scale in a sample of higher functioning adolescents with autism spectrum disorders and comorbid anxiety disorders enrolled in a randomized controlled trial (n = 30). Pretreatment Developmental Disability–Child Global Assessment Scale scores correlated with severity of autism spectrum disorders core symptoms (r = −.388, p = .034), pragmatic communication (r = .407, p = .032), and verbal ability (r = .449, p = .013) and did not correlate with severity of anxiety symptoms or with parent-reported adaptive behavior. Change in Developmental Disability–Child Global Assessment Scale scores during treatment was associated with autism spectrum disorders symptomatic improvement (r = .414, p = .040) and with improved general communication (r = .499, p = .013). Results support the importance of assessing global functioning in addition to symptom change and treatment response in clinical trials.

Keywords
adolescents, autism, global functioning, treatment
The use of symptom-specific measures not developed specifically for individuals with ASD can be challenging. Clients (with ASD) have been reported to display psychiatric symptoms in a somewhat atypical way (e.g. anxiety manifested as heightened rigidity; White et al., 2009). Therefore, these measures may not assess key psychiatric symptoms. Also, there is tremendous heterogeneity across people with ASD in core disabilities (e.g. some affected individuals are highly socially motivated yet awkward and unskilled, whereas others are more aloof and socially disinterested) and abilities (e.g. some are cognitively gifted, whereas others are intellectually disabled; cf. Volkmar et al., 2011). Because individuals with ASD do not typically present a unified, prominent problematic symptom or behavior, but rather a myriad, a narrow focus on improvement in a single symptom domain may fail to capture the full range of possible functioning or change. Although measuring change in the targeted behavioral domain is necessary methodologically, the full range of a participant’s abilities and deficits may not be captured if global measures are not included. It has been suggested that assessments occur at the level of the targeted symptoms and at the level of global functioning (Lord et al., 2005), as a narrow focus on improvement in a single symptom domain may result in a failure to capture potential improvement on broader aspects of functioning (Volkmar et al., 2011). Outcome measures sensitive to change in global functioning designed for use in the ASD population are needed (Volkmar et al., 2011). Wagner et al. (2007) addressed this need by modifying the Children’s Global Assessment Scale (CGAS; Shaffer et al., 1983) for children with developmental disabilities to create the Developmental Disability–Child Global Assessment Scale (DD-CGAS). The original CGAS was designed to measure functioning in children and has been found to be sensitive to treatment change in clinical trials (e.g. Frick et al., 1994; Geller et al., 2012; Mufson et al., 2004). However, the CGAS may not be easily used in samples of children with ASD owing to the nature and severity of ASD-related impairments and the atypical developmental trajectories often seen in people with ASD (Wagner et al., 2007). The DD-CGAS uses language that reflects a broader range of developmental levels and expectations and focuses attention on four domains of functioning: self-care, communication, social behavior, and school/academic performance (Wagner et al., 2007).

Ratings on the DD-CGAS have been shown to have moderate levels of convergent validity with measures that evaluate similar, yet conceptually distinct, constructs and to be sensitive to treatment change (Wagner et al., 2007). Previous research on the sensitivity of the DD-CGAS to change with treatment was completed using a small number of participants from a large clinical trial in which there was no randomization to condition. In Wagner et al.’s (2007) study, treatment sensitivity was established based on a comparison to another measure known to have treatment sensitivity: the Aberrant Behavior Checklist–Irritability Scale (Aman et al., 1985). The utility of the DD-CGAS could be strengthened if it is shown to be sensitive to treatment changes in a randomized controlled trial (RCT), with administration by independent evaluators (IEs). Chambless and Hollon (1998) asserted that outcome measures that are used to gather empirical support for psychological treatments should not only have demonstrated reliability and validity but also, in the case of clinician-ratings, should be completed by blind-to-treatment-assignment-raters, or IEs.

Given the previously described concerns about the use of measures developed for non-ASD patients (e.g. missing atypical symptom manifestations), the potential poor sensitivity of diagnostic measures to detect meaningful improvements, and the importance of attending to change in global functioning in addition to symptomatic change, it may be that researchers overlook clinically significant improvements within their intervention trials due to the lack of appropriate and sensitive outcome measures that assess daily functioning. The DD-CGAS may be a viable option for measuring subtle changes in overall functioning in children with ASD. This study was undertaken to further explore the psychometric properties of the DD-CGAS, including its potential utility as a measure of global improvement with treatment, in an older, higher functioning ASD sample than used in the original study by Wagner et al. (2007). The mean age of the Wagner et al. sample was 7.6 years, and approximately a quarter of the sample was nonverbal, with a minimum assessed IQ of at least 35.

In this study, we examined the psychometric properties of the DD-CGAS, rated by IEs, in the context of an RCT with adolescents with ASD. We hypothesized that the DD-CGAS would be a valid and sensitive measure of change in global functioning in a sample of youth with ASD. Specifically, we anticipated that scores on the DD-CGAS, prior to treatment, would be significantly positively correlated with adaptive behavior scores (particularly daily living skills), pragmatic communication, and verbal IQ, and negatively correlated with parent-reported ASD severity and child anxiety, but not correlated with age. We also hypothesized that students in regular, mainstream classes would have significantly higher DD-CGAS ratings at baseline than those who were in special education classes. Significant relationships in the hypothesized directions would support the convergent and discriminant validity of the DD-CGAS. Additionally, it was expected that change during treatment (baseline to posttreatment) on the DD-CGAS would correlate with change in social functioning, anxiety, and pragmatic communication, and that there would be significantly greater improvement, measured by the DD-CGAS, for participants in the treatment group compared to those in the waitlist group. Finally, we anticipated that participants who
showed a positive response to treatment (i.e. treatment responders), regardless of initial group assignment (treatment or waitlist), would have greater improvement on the DD-CGAS than treatment nonresponders.

**Method**

**Participants**

Thirty adolescents between the ages of 12 and 17 years participated, of whom 15 were randomly assigned to a 14-week cognitive-behavioral treatment program for anxiety and social skills and 15 to a waitlist (control) group (see White et al., 2013, for more detail on methodology and sample). All participants had a clinical diagnosis of ASD, confirmed by either the ADOS (Lord et al., 2002) or ADI-R (Lord et al., 1994), and met diagnostic criteria for at least one anxiety disorder (social phobia, generalized anxiety disorder, separation anxiety disorder) as determined by the Anxiety Disorders Interview Schedule–Child/Parent Version (ADIS-C/P; Silverman and Albano, 1996). All participants had a current verbal IQ of 70 or greater as measured by the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999).

**Measures**

**DD-CGAS.** The DD-CGAS is a measure of global functioning for children with developmental disabilities (Wagner et al., 2007). IEs, masked to participants’ assigned treatment conditions, assign scores, which range from 1 to 100, based on all available information about the child’s functioning in the four domains of self-care, communication, social functioning, and school/academic performance. Ratings were made based on the child’s “typical” behavior over the previous 2 weeks. Higher scores indicate better overall functioning, and ratings can typically be completed in less than 10 min. The ratings are divided by deciles; a description of the type of functioning one may observe for a score within each decile is included within the DD-CGAS rater instructions. Scores above 70 indicate functioning at a level consistent with a typically developing child (Wagner et al., 2007). DD-CGAS scores were assigned by IEs, based on review of all completed measures and interviews at the given assessment (baseline or endpoint). If any piece of information necessary for assigning a DD-CGAS score was missing (e.g. current school placement), the IE sought this information from the parents or adolescent during the assessment visit.

All DD-CGAS raters were trained to reliability using the criterion set forth by Wagner et al. (2007). Briefly, after completing relevant readings and developing familiarity with the DD-CGAS measure, raters met as a group to discuss the training cases and practice assigning ratings. Then, every rater was assigned the first round of six vignettes in the reliability set to code independently, prior to a subsequent training meeting to discuss the independent ratings. A rater was considered reliable when their ratings fell within 10 points of “gold standard” ratings established by Wagner et al. on at least 80% of a set of DD-CGAS vignettes (Wagner et al., 2007). Raters who did not meet this criterion were given more training and asked to rate additional sets of reliability vignettes until the criterion was met. Over a 1-year period, a total of eight raters on the trial were trained to reliability, although only three of them were used as IEs to actually complete the DD-CGAS in the trial, two of whom were graduate students in clinical psychology and one of whom was a postbaccalaureate research assistant. Data evaluating “drift” of ratings over time were available from one rater (the person who did most of the pre- and postintervention assessments). Eleven months after initial training, she completed two rounds of reliability vignettes. Her ratings indicated that drift was minimal, as she was reliable on four of six vignettes in the first set, and six of six in the second set of vignettes.

**Children’s Communication Checklist-2.** The Children’s Communication Checklist-2 (CCC-2) is a 70-item questionnaire used to assess pragmatic communication (Bishop, 2003). Parents are asked to rate each item on a 0–3 scale (0 = less than once a week; 1 = at least once a week, but not every day; 2 = once or twice a day; and 3 = several times a day), and higher general composite scores indicate greater ability. Strong internal consistency (α = .95) and concurrent validity have been demonstrated for the CCC-2 (Bishop, 2003). Internal consistency was high in this sample (α = .940).

**Child and Adolescent Symptom Inventory ASD Anxiety Scale.** Drawn from a larger pool of anxiety items from the Child Symptom Inventory (Gadow and Sprafkin, 1997) and the Adolescent Symptom Inventory (Gadow and Sprafkin, 1998), the Child and Adolescent Symptom Inventory ASD Anxiety Scale (CASI-Anx) is a 20-item measure of anxiety symptoms (Sukhodolsky et al., 2008). Parents are asked to rate each item on a 0–3 scale (0 = never, 1 = sometimes, 2 = often, and 3 = very often), which are summed to yield a total score. The CASI-Anx scale has internal consistency of 0.85 and little or no overlap with symptoms of ASD (Sukhodolsky et al., 2008). In this sample, internal consistency was high (α = .852).

**Clinical Global Impressions-Improvement scale.** The Clinical Global Impressions-Improvement (CGI-I) scale is a 7-point (1 = very much improved, 4 = unchanged, and 7 = very much worse) scale designed to measure overall symptomatic change with intervention (Guy, 1976). In this study, the CGI-I was used as a categorical (responder vs nonresponder) outcome measure to assess changes in global functioning (including functioning in school, activities of daily living, social activities, and home). Participants with
CGI-I ratings of 1 and 2 (i.e. “very much” or “much” improved) were considered treatment responders, and participants with CGI-I ratings of 3 (i.e. “minimally” improved) or higher were considered nonresponders. The masked IE interviewed the parent and adolescent together at preintervention to assess severity and again at postintervention (immediately posttreatment) to assess improvement. All IEs were trained to reliability using a series of case vignettes. Reliability was demonstrated when the IE assigned the severity and improvement ratings within one point of the “gold standard” rater on at least three training vignettes.

**Social Responsiveness Scale.** The Social Responsiveness Scale (SRS) is a 65-item parent-report of ASD-related deficits (Constantino and Gruber, 2005). The SRS captures total social impairment and comprises five subscales: social communication, social motivation, social cognition, social awareness, and autistic mannerisms. Higher scores indicate more impairment, and each item is rated on a 4-point Likert scale (1 = not true, 2 = sometimes true, 3 = often true, and 4 = almost always true). The SRS has strong internal consistency (α = .97) and test–retest reliability (α = .77–.85) and shows evidence of both concurrent and discriminant validity (Constantino and Gruber, 2005). In this sample, internal consistency was high (α = .934).

**School placement.** School placement data were taken from parent-report on a demographic questionnaire. Parents indicated whether their children were enrolled in mainstream (i.e. regular education) or special education classes. If a participant was enrolled in special education classes, parents were asked to indicate whether the child was in the special education classroom full time or part time. For the purposes of this study, participants were split into those who received any level of special education and those who were fully immersed in mainstream classes, as only one participant was in special education classes full time.

**Vineland Adaptive Behavior Scales–Second Edition.** The Vineland is a parent-report measure designed to measure the child’s competence in communication, daily living skills, and socialization (Sparrow et al., 2005). Used extensively in studies of children with developmental disabilities, the Vineland has demonstrated excellent reliability and validity (Sparrow et al., 2005). Both the composite adaptive behavior score and the daily living subscale score were used for analyses in this study.

**Procedure**

The study was approved by the institution’s review board. Demographic and adaptive behavior data were collected at the screening visit, when diagnoses were determined and eligibility for participation established. All other measures were completed prior to randomization, at the baseline visit (i.e. immediately prior to either beginning treatment or waitlist period). The endpoint visit occurred immediately after the treatment or waitlist period (approximately 14 weeks after baseline). Following the first endpoint, participants who were assigned to the waitlist condition received the active intervention and then were reassessed (second endpoint) upon completion of the intervention, approximately 28 weeks after the baseline visit. The treatment (White et al., 2013) developed specifically for adolescents aged 12 through 17 years with high-functioning ASD and co-occurring anxiety, integrated a social skill development focus with evidence-based approaches for the treatment of childhood anxiety.

**Statistical analyses**

Analyses were completed with IBM SPSS Statistics Version 20. To assess convergent validity, bivariate correlations were computed to examine relationships with other measures that would be expected to be related to overall functioning (e.g. social functioning, anxiety symptoms), and an independent means t-test was used to compare baseline DD-CGAS scores between those participants enrolled in mainstream classes exclusively and those participants enrolled in special education classes. Discriminant validity was examined by computing the Pearson correlation between baseline DD-CGAS ratings and participants’ age in months. All participants completed the baseline assessment and were included in these analyses. However, information about classroom placement was not available for one participant, and CCC-2 baseline score was not available for two participants, so these analyses only included 29 and 28 participants, respectively.

To examine sensitivity to change in DD-CGAS ratings over time, change scores were calculated for measures administered at baseline and endpoint visits such that, regardless of the measure, higher scores indicate improvement. Because not all measures were administered to the waitlist participants during the second endpoint visit, change scores (in Table 2) reflect change from baseline to endpoint during the experimental period only, when the waitlist participants did not receive intervention and the treatment group did (see Figure 1). Two participants’ CCC-2 baseline scores were missing, so change scores for those participants could not be computed. Bivariate correlations were used to examine the relationship between DD-CGAS change and change scores on measures of social functioning, general communication, and anxiety for 25 of the original participants. Five participants were excluded from these analyses: two participants from the treatment group completed fewer than 12 individual therapy sessions (i.e. did not receive a full “dose” of the treatment) and three participants in the waitlist group dropped out before completing the first endpoint.
visit (reasons cited included maternal health complications, child hospitalization, and lack of time). There were no differences in the treatment and waitlist groups on demographic or outcome variables, at baseline (see White et al., 2013). An independent means t-test was run to compare DD-CGAS change scores between the treatment group (after treatment) and the waitlist group (after waiting period).

Finally, an independent means t-test was used to compare DD-CGAS change scores between the treatment responders and treatment nonresponders, based on the CGI-I. CGI-I scores were assigned after completion of the treatment (i.e. at first endpoint for treatment group and second endpoint for waitlist group) and were used to determine whether a participant was a treatment responder or not. DD-CGAS change scores for these analyses were computed by subtracting the pretreatment score (i.e. baseline for the treatment group and first endpoint for waitlist group) from the posttreatment score (i.e. endpoint for the treatment group and second endpoint for the waitlist group). In addition to the five participants excluded from analyses above, three additional participants were excluded from this analysis because they did not complete the second endpoint (reasons cited included scheduling difficulty and child hospitalization).

**Results**

Descriptive statistics for all measures are included in Tables 1 and 2. Baseline DD-CGAS ratings were, as expected, negatively correlated with baseline ASD-related disability, as measured by the SRS ($r = -0.388$, $p = 0.034$). As parent-rated ASD severity increased, baseline DD-CGAS ratings decreased. Additionally, baseline DD-CGAS ratings were positively correlated with baseline pragmatic communication scores, as measured by the CCC-2 ($r = 0.407$, $p = 0.032$). Participants with higher communication abilities were rated by clinicians to have higher global functioning scores. Finally, baseline DD-CGAS scores were positively correlated with verbal IQ ($r = 0.449$, $p = 0.013$). However, baseline DD-CGAS ratings were not significantly correlated with parent-reported adaptive behavior composite scores ($r = -0.226$, $p = 0.229$), parent-reported daily living scores ($r = -0.157$, $p = 0.407$), or parent-reported anxiety symptoms ($r = 0.002$, $p = 0.990$). There were also no significant differences in DD-CGAS ratings between participants in full/partial special education classrooms ($n = 7$; $M = 55.29$, standard deviation (SD) = 14.21) and those in mainstream, regular education classrooms ($n = 22$; $M = 60.00$, SD = 9.16), $t(27) = 1.036$, $p = 0.310$. As hypothesized, baseline DD-CGAS ratings were not significantly correlated with participant age ($r = 0.003$, $p = 0.987$).

When correlations between DD-CGAS change and change scores on various measures were examined, improvement on the DD-CGAS was found to be related to decreased ASD symptoms, as measured by the SRS ($r = -0.414$, $p = 0.040$), and with improved general communication, as measured by the CCC-2 ($r = 0.499$, $p = 0.013$), but not with reduction in anxiety, as measured by the CASI-Anx ($r = -0.298$, $p = 0.148$). An independent samples $t$-test revealed that the mean change in DD-CGAS scores was greater for those participants in the active treatment condition than those in the waitlist control condition.

Table 1. Descriptive statistics for screening and baseline measures.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>30</td>
<td>14.59</td>
<td>1.63</td>
<td>12.00–17.42</td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>30</td>
<td>97.07</td>
<td>14.46</td>
<td>73–126</td>
</tr>
<tr>
<td>DD-CGAS</td>
<td>30</td>
<td>58.90</td>
<td>10.32</td>
<td>30–83</td>
</tr>
<tr>
<td>SRS</td>
<td>30</td>
<td>87.30</td>
<td>13.13</td>
<td>59–115</td>
</tr>
<tr>
<td>CCC-2</td>
<td>28</td>
<td>70.25</td>
<td>14.14</td>
<td>42–107</td>
</tr>
<tr>
<td>Vineland Adaptive Behavior Composite</td>
<td>30</td>
<td>71.83</td>
<td>10.60</td>
<td>58–94</td>
</tr>
<tr>
<td>Vineland Daily Living Skills</td>
<td>30</td>
<td>78.40</td>
<td>16.08</td>
<td>52–125</td>
</tr>
<tr>
<td>CASI-Anx</td>
<td>30</td>
<td>18.50</td>
<td>9.10</td>
<td>5–39</td>
</tr>
</tbody>
</table>

SD: standard deviation; DD-CGAS: Developmental Disability–Child Global Assessment Scale; SRS: Social Responsiveness Scale; CCC-2: Children’s Communication Checklist-2; CASI-Anx: Child and Adolescent Symptom Inventory ASD Anxiety Scale.
Participants in the treatment group showed larger increases on the DD-CGAS from baseline to endpoint than did those who were in the waitlist group, who did not receive the intervention during this period. DD-CGAS change was not significantly larger for treatment responders (n = 13; M = 8.54, SD = 8.55), based on the CGI-I, compared to nonresponders (n = 9; M = 4.89, SD = 3.55), t(20) = −1.203, p = .243.

Discussion

This study was undertaken to evaluate the utility and sensitivity of the DD-CGAS as a measure of daily functioning for children with ASD. Evidence-based, validated tools with which to measure complex change in functioning in people with ASD are critical to the development of efficacious treatments and necessary for guiding clinical practice (e.g. Ollendick and White, 2013). In general, results indicate that the DD-CGAS can be easily adopted, and raters can be efficiently trained to reliability standards for administration. In addition, the DD-CGAS appears to provide unique information from indices of treatment response and symptomatic change.

As hypothesized, DD-CGAS scores were strongly correlated with parent-reported degree of ASD-related impairment and pragmatic communication, such that youth with more severe communicative and social impairments were rated as having lower overall functioning. DD-CGAS scores were also negatively correlated with verbal IQ, as expected. Contrary to what we hypothesized, there was no relationship between DD-CGAS scores and parent-reported anxiety scores, adaptive behavior scores, or educational placement. It is possible that ASD severity, verbal ability, and pragmatic communication are strongly predictive of overall functioning in adolescents with ASD, leaving little variance for potential influence from co-occurring anxiety. This is consistent with the extant research on predictors of adult outcome in ASD, with the strongest predictors of positive outcome being cognitive ability and expressive language (Billstedt et al., 2005; Howlin et al., 2000). The lack of association between global functioning and anxiety severity may also be due to the nature of the sample, which was by definition highly anxious and treatment-seeking.

There is mixed support for our hypothesis that change in global functioning would relate to change in symptomatic improvement and treatment response. Treatment responders did not have significantly higher DD-CGAS ratings than did nonresponders. Change in functioning, as reflected on the DD-CGAS, was related more to change in parent-reported ASD severity than to change in parent-reported anxiety. Although further research is necessary to explore this finding, it might be that a potent “mechanism of action” in improving global function is to alleviate, to some degree, the severity of the ASD. It is also possible that the DD-CGAS, which was specifically developed for children with ASD, aligns better with a measure of ASD severity than with indices of other domains of pathology such as anxiety. Regardless, these findings support the assertion (e.g. Kazdin, 2005) that it is important to assess global functioning separate from change in specific symptoms or impairment.

The primary limitation of this study relates to the scope of the project. Data were collected in the context of a single, albeit randomized, treatment study, and it is possible that particular aspects of this sample or the treatment program affected results. Further exploration of the DD-CGAS should be conducted, using more heterogeneous samples and other psychosocial and biosocial treatment approaches. A larger sample would also have strengthened the generalizability of the findings and allowed for more sophisticated analytic approaches, such as examination of potential moderators of change in the DD-CGAS during treatment. Additionally, it would have been ideal to have each participant rated independently by two IEs to assess interrater reliability.

Table 2. Descriptive statistics for change scores during the experimental period.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD-CGAS–change score</td>
<td>Treatment group</td>
<td>13</td>
<td>7.08</td>
<td>6.33</td>
</tr>
<tr>
<td></td>
<td>Waitlist group</td>
<td>12</td>
<td>0.75</td>
<td>5.53</td>
</tr>
<tr>
<td>SRS—change score</td>
<td>Treatment group</td>
<td>13</td>
<td>15.62</td>
<td>16.37</td>
</tr>
<tr>
<td></td>
<td>Waitlist group</td>
<td>12</td>
<td>0.75</td>
<td>4.83</td>
</tr>
<tr>
<td>CCC-2—change score</td>
<td>Treatment group</td>
<td>13</td>
<td>6.92</td>
<td>11.38</td>
</tr>
<tr>
<td></td>
<td>Waitlist group</td>
<td>11</td>
<td>4.00</td>
<td>4.10</td>
</tr>
<tr>
<td>CASI-Anx—change score</td>
<td>Treatment group</td>
<td>13</td>
<td>5.38</td>
<td>11.11</td>
</tr>
<tr>
<td></td>
<td>Waitlist group</td>
<td>12</td>
<td>1.50</td>
<td>4.21</td>
</tr>
</tbody>
</table>

SD: standard deviation; DD-CGAS: Developmental Disability–Child Global Assessment Scale; SRS: Social Responsiveness Scale; CCC-2: Children’s Communication Checklist-2; CASI-Anx: Child and Adolescent Symptom Inventory ASD Anxiety Scale.
agreement. Despite these limitations, this study supports use of the DD-CGAS as a brief, clinician-administered tool that can be easily adopted for use in treatment outcomes studies to assess global functioning in young people with ASD. Moreover, it appears to be sensitive to change, and there is evidence of its validity as a measure of global functioning in this population.

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