Test Review

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Childhood Autism Rating Scale (2nd ed.). Los Angeles, CA: Western Psychological Services, 2010.

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Test Description

General Description

The Childhood Autism Rating Scale–Second Edition (CARS2), consists of three rating forms designed to identify symptoms associated with autism spectrum disorders (ASD). Published in 2010, the CARS2 builds on its predecessor by adding an additional rating scale intended to identify individuals with high-functioning autism (CARS2-HF). More specifically, the CARS2-HF can be used for individuals age six and older who have an IQ above 80 and who exhibit fluent communication. The original Childhood Autism Rating Scale (CARS) has been retained in its original form and renamed the Childhood Autism Rating Scale–Second Edition—Standard Version (CARS2-ST). In addition to the CARS2-ST and CARS2-HF, the second edition includes a new parent rating scale, the Questionnaire for Parents or Caregivers (CARS2-QPC), which may be used in tandem with the CARS2-ST or the CARS2-HF.

The CARS2 is not meant as a universal screening measure and should be used only to inform diagnostic hypotheses for children suspected of falling within the ASD category. In other words, the CARS2 is used to provide additional information when a diagnosis of ASD has already been made or is highly suspected. Results provide information not only on the presence of ASD symptoms, but also the intensity and duration of these symptoms, thus providing a more comprehensive picture of an individual's functioning. Furthermore, the utility of the CARS2 extends beyond informing diagnosis; results may be used for intervention planning, providing diagnostic feedback to parents, and creating "functional profiles."

Although the original CARS demonstrated excellent value as an empirically supported tool for supporting diagnosis of children with autism, its utility has been limited by the evolving definition of autism from that of a discreet diagnostic category to a spectrum disorder. As a result, core items on the CARS2 were refined to be more sensitive to detecting ASD symptoms in children and adults with high-functioning autism and Asperger's disorder. Modified rating areas include emotional expression and regulation of emotions, relating to people, fear or anxiety, and level and consistency of intellectual response. Two new items, social-emotional understanding and thinking/cognitive integration skills, were added to the CARS2-HF.

The CARS2 may be used in a variety of settings, including schools, clinics, and intervention programs. As a rating scale system, the CARS2 is easy to learn and can be administered by a wide range of professionals, provided they have training with individuals with autism. As the CARS2 is a rating system of individual behavior, the measure is not intended for group administration.

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Specific Description

Both the standard and high-functioning versions of the CARS2 consist of 15 items. Each item corresponds to a specific domain of functioning potentially related to autism diagnosis. Examiners rate examinees according to one of four rating values, with a rating of "1" indicating that an individual's behavior is within normal limits, and a rating of "4" indicating that an individual's behavior is markedly abnormal/severe as compared to same-age peers. Examiners are allowed to use midpoints of the scores when they perceive an individual's behavior as falling between two rating values; therefore, examiners have the option of assigning individuals one of seven ratings for each item. Detailed rating instructions in the rating booklets provide comprehensive explanations of each of the 15 items, including specific examples of behaviors represented by each rating level; there are no subscale scores, only the total score. The manual provides additional considerations for rating behavior, including how each behavior is best assessed. Rating values are summed to produce a total raw score, which can then be converted to a T-score and corresponding percentile rank. T-scores indicate symptom level compared to individuals with autism spectrum diagnoses. It should be noted that as the purpose of the CARS2 is to provide more detailed information about individuals with a diagnosis of ASD (or who are highly suspected of having a diagnosis), the norming samples for both forms of the CARS2 are comprised solely of individuals with ASD. This must be taken into consideration when interpreting scores on the CARS2, as scores reflect functioning relative to a specific population (ASD) rather than typically developing children. Both the CARS2-ST and CARS2-HF provide cutoff score values intended to inform examiners of further need for evaluation of the presence of autism. The CARS2 parent/caregiver form is organized into seven sections; the first six include four to nine statements for which parents or caregivers are required to rate the individual's functioning on a 5-point Likert-type scale. The seventh section allows for open-ended responses to questions about other behaviors not described in previous sections. The rater may also add additional behavior examples for up to three items.

Test Materials and Stimuli

The layout of the CARS2 is intuitive and user friendly. Items are labeled according to which domain of functioning they are designed to assess, and descriptions under each rating value provide examples of behavior corresponding to each rating. Items are gender neutral; no evidence of sex bias exists. The text for rating value descriptions is small, but written in font that is easy to read. Below each rating value and subsequent description, space is provided for recording related observations of the individual. Forms are color coded, which is helpful, given that the front pages of the CARS2-ST and CARS2-HF appear nearly identical on first glance. To aid with interpretation, the manual provides information on items most and least likely to receive high ratings for specific age groups and diagnoses. The manual also provides guidelines for intervention planning based on item responses. Case examples are included to illustrate guidelines for "real-life" situations. The test manual is clearly organized into sections covering administration, scoring, interpretation, and intervention planning. The technical guide provides a thorough overview of item development and psychometric properties of the test.

Technical Adequacy

Test Construction and Item Analysis

The CARS2-ST retained all items from the CARS; thus, item-development procedures did not change from the original version. Similarly, test construction for the CARS2-HF differed only

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slightly from that of the original CARS. Most item areas from the CARS were retained on the CARS2-HF; however, definitions for items on the high-functioning version were refined to capture more subtle aspects of behavior that might be exhibited by individuals with near-average or better intellectual skills. New items were included based on growing research evidence of difficulties with theory of mind and social perspective taking, central coherence, and abstract reasoning for higher functioning individuals with autism. With the exception of the added items, development procedures did not differ between the CARS2-ST and the CARS2-HF. As with the CARS, items were developed in accordance with diagnostic criteria from the five major diagnostic systems for autism. Raw scores on the CARS2-ST and CARS2-HF range from a minimum score of 15, indicating minimal symptoms of ASD, to a maximum score of 60, indicating severe symptoms of ASD.

Standardization Samples

Three large samples were used for purposes of standardization: The original CARS development sample ($N = 1,606$), the current CARS2-ST verification sample ($N = 1,034$), and the CARS2-HF developmental sample ($N = 994$), for a total sample of over 3,500 children and adults. Ratings on all three forms of the test were studied in smaller clinical samples, as well. The original CARS developmental sample is described in detail in the test manual.

The CARS2-ST verification sample differed substantially from the original CARS sample, with the exception of gender and socioeconomic status makeup. Ages of individuals within the CARS2-ST verification sample ranged from 2 to 36. The ethnicity of the sample was more varied, as well; 60% of the sample identified themselves as White, 16% as Black/African American, 13% as Hispanic/Latino, 7% as Asian/Pacific Islander, and 7% as Other. Whereas the sample for the original CARS did not indicate cutoffs for IQ scores, the distribution of full scale IQs for the CARS2-ST verification sample was capped at 85, in keeping with the presumption that CARS2-ST is intended primarily for use with individuals with low cognitive functioning. Both the original CARS sample and the CARS2-ST verification sample included a substantial number of individuals with IQs below 70.

The CARS2-HF sample was similar in composition to the CARS2-ST sample, particularly with regard to age and gender. The sample included individuals ages 6 to 57 with a variety of clinical diagnoses, including high functioning autism ($n = 248$), Asperger's disorder ($n = 231$), PDD-NOS ($n = 95$), ADHD ($n = 179$), learning disorder ($n = 111$), and other internalizing and externalizing disorders ($n = 69$). The sample also included small groups of general education students ($n = 21$) and nonautistic students in special education programs ($n = 40$). All sample participants had an IQ of 80 and above, consistent with the premise that the CARS2-HF is intended for use with individuals of average or better cognitive abilities.

Reliability

As with the original CARS, internal consistency reliability coefficients were robust for the CARS2-ST (.93) and the CARS2-HF (.96). Item-to-item correlations ranged from .43 to .81 on the CARS2-ST and from .53 to .88 on the CARS2-HF. The overall interrater reliability estimate for the original CARS was .84, with reliability estimates for item ratings ranging from .55 (*level and consistency of intellectual response*) to .93 (*relating to people*). For the CARS2-HF, the interrater reliability estimate obtained for total scores was .95, indicating generally good agreement between raters. Item rating reliability estimates ranged from .51 (*level and consistency of intellectual response*) to .90 (*general impressions*). Interrater reliability estimates were not provided for the CARS2-ST. As the CARS2 is intended for use by a wide variety of professionals who are not necessarily experts in autism, interrater reliability was also assessed by comparing

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ratings made by visiting professionals with limited autism experience with ratings made by expert clinical directors. Correlation of visitors' total scores with directors' total scores on the original CARS was .83 ($p < .01$). Similarly, interrater reliability estimates for the CARS were calculated for ratings given by different professionals based on various sources of clinical information about referred individuals; these correlations ranged from .73 to .82, indicating good agreement.

Validity

Validity of the internal structure of the CARS2 was assessed by calculating correlations between item ratings and total raw scores. For both the CARS2-ST and the CARS2-HF, correlations among item ratings were moderate to high, ranging from .42 to .77 for the CARS2-ST and from .40 to .79 for the CARS2-HF. Factor analyses were conducted for both the CARS2-ST and CARS2-HF; notably, neither of the factor analyses was consistent with the autistic triad of communication, social relations, and repetitive/restrictive behaviors ([*Diagnostic and statistical manual of mental disorders*, 4th ed., text revision]; American Psychiatric Association, 2000). Sensitivity and specificity of the original CARS instrument was observed using a total raw score cutoff value of 30; use of this cutoff value correctly identified 87% of individuals in the development sample as autistic or not autistic. Using the total raw score alone, identification of those with or without an autism diagnosis resulted in a sensitivity value of .88 and a specificity value of .86. Ratings for the CARS2-ST sample were consistent with these findings. Similarly, sensitivity and specificity values for the CARS2-HF for distinguishing high-functioning individuals with ASD from all nonautism groups in the sample were .81 and .87, respectively. Rating patterns were compared across groups with different diagnoses, levels of cognitive function, and age. For the CARS2-ST sample, a shift in ratings occurred for those with a diagnosis of autism and a higher level of cognitive functioning; however, these differences were not statistically significant. Differences in rating patterns also existed between older individuals with autism and younger individuals with autism. Analysis of rating patterns on the CARS2-HF revealed substantial differences between individuals with Asperger's disorder and individuals diagnosed with autism.

Concurrent validity was demonstrated by comparing total scores on the CARS2-ST and CARS2-HF with results obtained from other measures of autism. Correlations with the Autism Diagnostic Observation Schedule (ADOS; Lord & Corsello, 2005) were .79 for the CARS2-ST total score and .77 for the CARS2-HF total score, indicating a fairly strong relationship between clinician ratings. The correlation between clinician-generated scores on the CARS2-HF total score and mothers' scores on the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) was moderate (.47), as was the correlation between the CARS2-ST total score and the SRS (.38). The correlation between the CARS2-ST and the Autism Behavior Checklist (ABC; Krug, Arick, & Almond, 1980) was stronger, at .67.

Commentary and Recommendations

The inclusion of a new, high-functioning version of the CARS2 is indicative of the changing definition of autism from that of a discrete diagnostic category to a spectrum disorder. Both the CARS2-HF and the CARS2-ST retain the framework of the original CARS. The CARS2 is a useful tool for supporting the diagnostic process and for forming intervention recommendations once a diagnosis has been made. It is not intended for use as a diagnostic tool; clinicians should take care to ensure that CARS2 results are represented accurately when sharing them with clients, families, and other professionals. Content of the CARS2-ST and CARS2-HF items is consistent with the core criteria of the five diagnostic systems on which the scales were based; however the factor structure of the CARS2 is not consistent with the current diagnostic criteria (APA, 2000).

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Standardization samples were adequate and were generally representative of the populations the CARS2 purports to assess. Reliability was appropriate for informing diagnosis and research. Validity was adequately established and indicated that interpretation of scores from the CARS2 is accurate across settings, informants, and age groups. Overall, the CARS2 is a comprehensive measure for the assessment of behavioral problems related to autism.

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