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Test Review: Cognitive Assessment System-Second Edition (CAS2)

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Reviewer notes

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Test Review: Cognitive Assessment System-Second Edition (CAS2)

Test Description

General Description

The Cognitive Assessment System-Second Edition (CAS2) is an individually administered measure of cognitive ability designed for children and adolescents ages 5 through 18 years. The measure, authored by Jack A. Naglieri, J. P. Das, and Sam Goldstein, was published by Pro-Ed in 2014 and is the first revision of the Cognitive Assessment System (CAS; Naglieri & Das, 1997). The CAS2 is designed to measure basic psychological processing abilities, resulting largely from the work of Russian neuropsychologist A. R. Luria. Luria (1973) suggested that the brain processes stimuli largely on the basis of interactions between different functional units. From the Lurian perspective, individual units cannot function without input from other units thus, the integration of cognitive processing as a whole is vital to understanding brain functioning (Naglieri & Otero, 2012). The CAS2 operationalizes the Lurian framework using the Planning, Attention, Simultaneous, and Successive (PASS) model of cognitive processing. Although beyond the scope of the present review, interested readers are encouraged to consult Das, Naglieri, and Kirby (1994) for an in depth review of the PASS model.

According to the authors, the CAS2 can be administered in clinical and research settings, and can be used to diagnose learning strengths and weaknesses as well as provide relevant information to clinicians for the correct diagnoses of ADHD, specific learning disability, intellectual disability, and traumatic brain injury. Additionally, the measure is designed to identify intra-individual (idiographic) as well as normative (nomothetic) cognitive strengths and weaknesses via composite and subtest scores. As a result of these features, the CAS2 is potentially a useful measure for assessment professionals (e.g., school psychologists) who

engage in high stakes assessments that result in eligibility decisions for special education and related services. The CAS2 should only be administered by professionals who have received appropriate training in the administration and interpretation of psychoeducational measures, and ethics and guidelines for appropriate test use. Although the administration manual does not provide estimates as to the length of time required to administer the measure, previous estimates of the CAS (e.g., Naglieri, 1999) have suggested that administration of the core battery takes approximately 60 minutes.

It should be noted that users of the CAS2 have the option of utilizing the instrument as part of a comprehensive multi-method PASS-based assessment to intervention package that features a CAS2-based cognitive-behavioral rating scale as well as an intervention handbook (Naglieri & Pickering, 2010). These products are not included in the CAS2 test kit and thus they will not be reviewed here.

Specific Description

The CAS2 features 13 subtests that can be utilized as part of an 8-subtest core battery or a 12-subtest extended battery. Although several of the subtests have been renamed, most of the original CAS subtests have been retained. Structural modifications were limited to the Successive scale and include the elimination of the Speech Rate measure and the addition of a new Visual Digit Span subtest in order to diversify presentation format within the scale. Consistent with the previous edition, the CAS2 subtests combine to yield an overall full-scale score of cognitive functioning, four PASS composite scales (Planning, Attention, Simultaneous, and Successive), and five supplemental composite scales (Executive Functioning Without Working Memory, Executive Functioning With Working Memory, Working Memory, Verbal Content, and Nonverbal Content). It should be noted that the supplemental composites are a new

feature in the current edition. Each PASS composite contains two core subtests, and an additional supplementary subtest if the extended battery is selected. Each of the supplemental composites contain combinations of two to four core subtests. The CAS2 composite scales are described in more detail below.

Planning: The ability to create a plan of action, apply the plan, verify that an action taken conforms to the original goal, and modify the plan as needed. The Planning composite is composed of the Planned Codes, Planned Connections, and Planned Number Matching subtests.

Attention: The ability to focus cognitively while detecting particular stimuli and inhibit response to irrelevant competing stimuli. The Attention composite is composed of the Expressive Attention, Number Detection, and Receptive Attention subtests.

Simultaneous: The ability to synthesize separate elements into an interrelated group. The Simultaneous composite is composed of the Matrices, Verbal-Spatial Relations, and Figure Memory subtests.

Successive: The ability to recall or comprehend a serial organization of events. The Successive composite is composed of the Word Series, Sentence Repetition (ages 5-7), Sentence Questions (ages 6-18), and Visual Digit Span subtests.

Executive Function Without Working Memory: A measure of a child's ability to achieve a goal by planning and organizing a task while paying careful attention to the stimuli and resisting distractions in the environment. The composite is composed of the Planned Connections and Expressive Attention subtests.

Executive Functioning With Working Memory: A measure of a child's executive functioning ability, while also keeping information in memory while problem solving.

The composite is composed of the Planned Connections, Verbal-Spatial Relations, Expressive Attention, and Sentence Repetition/Questions subtests.

Working Memory: The ability to store and mentally manipulate information for a short period of time. The composite is composed of the Verbal-Spatial Relations and Sentence Repetition/Questions subtests.

Verbal Content: The ability to solve problems that require recall and/or comprehension of verbal concepts or words. The composite is composed of the Verbal-Spatial Relations, Receptive Attention, and Sentence Repetition/Questions subtests.

Nonverbal Content: The ability to solve problems that contain images. The composite is composed of the Planned Codes, Matrices, and Figure Memory subtests.

In an effort to strengthen the reliability and validity of the CAS2, minor alterations to test content and administration procedures included: a) the addition of items to all retained subtests; b) the alteration of item content and administration time on several subtests; and c) the reorganization and rewriting of the administration and technical manuals.

Scoring System

Scoring can be done by hand or through an online scoring and report system; however, use of the online scoring system requires the purchase of an annual renewal license through the test publisher. Age-based conversion charts are provided in the administration manual which allow users to convert subtest raw scores into scaled scores, which have a mean of 10 and a standard deviation of 3. The resulting scaled scores are then summed to provide composite standard scores which have a mean of 100 and a standard deviation of 15. Separate core and extended battery conversion charts for the PASS composite scores are provided. Additionally,

each of the composite conversion charts also reports percentile ranks and confidence interval estimates that correspond to each of the derived standard scores.

Procedures for subtest-level item scoring on the CAS2 are consistent with the previous edition and are fairly objective and straightforward. Correct responses to the Matrices, Verbal-Spatial Relations, Expressive Attention, Word Series, Sentence Repetition, Sentence Questions, and Visual Digit Span subtests are provided in the examiner record form. To correctly score items from the Figure Memory subtest, examiners must score examinee drawings, on a pass or fail basis, based upon how closely the drawings visually correspond to correct answers provided in the administration and scoring manual. Calculating the raw scores for timed measures (e.g., Planned Codes, Planned Number Matching, Number Detection, Receptive Attention, and Expressive Attention) is a bit more complex; requiring the use of overlay transparencies to determine the number of correct items and the subsequent calculation of a ratio score using the number of items completed and the time to completion for each measure. Ratio scale conversion tables are provided within the examiner record form and are fairly intuitive to the examiner after several test administrations.

The CAS2 test record form also contains a supplementary worksheet for users to conduct intra-individual composite and subtest strengths and weaknesses analyses via ipsative procedures (Davis, 1959). In ipsative analysis, each of the obtained PASS composite standard scores are subtracted from the calculated mean for all the PASS measures, and the resulting difference score is determined to be statistically and/or clinically significant if it surpasses predetermined thresholds reported in the administration manual. These procedures can also be utilized to determine the significance of any observed within-composite subtest variance. Additional comparison options are also provided to assess the significance of test-retest discrepancies as

well as observed differences between measures that contain visual stimuli and those that contain auditory stimuli.

Consistent with other contemporary cognitive measures, the interpretive manual encourages users to interpret the CAS2 in a stepwise fashion beginning with a description of the full scale and composite scores prior to engaging in discrepancy analyses at both the composite and subtest level. Like its predecessor, the CAS2 also offers users the option of completing a strategy assessment procedure at the conclusion of each Planning subtest. This feature provides clinicians with a useful method for making qualitative inferences about an individual's performance on the measures. To this reviewer's knowledge, related methods of qualitative assessment can only be found on the Kaufman Assessment Battery for Children-Second Edition (KABC-II; Kaufman & Kaufman, 2004).

Test Materials and Stimuli

The CAS2 contains a folded administration and scoring manual, a soft cover interpretive and technical manual, three spiral-bound tab delimited stimulus books, a spiral bound scoring template, an examiner test record form, a student response book for selected Planning and Attention subtests, a Figure Memory response book, and a red pencil to be used by the examinee for responding. The aforementioned test materials are all generally well made and easy to use and understand. Users will find that the materials are fairly consistent with the previous edition of the instrument.

Technical Adequacy

Normative Sample

The normative sample consisted of 1,342 individuals, ages 5 to 18, from different communities in 19 states. The sample was constructed to be nationally representative using census estimates from 2011, and stratified according to demographic variables such as age, gender, region, ethnicity, exceptionality status, and parent education level. Age and demographic brackets were adequately represented although the composition of brackets differed across the age span. From ages 5 to 12, age brackets are reported in one year intervals however from ages 13-18 the brackets are reported in two year intervals. No rationale for this discrepancy is reported in the technical manual. As a result, the representativeness of the measure from ages 13-18 is somewhat obscured.

Reliability

Internal consistency was estimated using Cronbach's alpha for every subtest except Expressive Attention. The standardized version of the CAS2 included two alternate forms of the last Expressive Attention stimulus card. Thus, internal consistency for this subtest was estimated using alternate-forms reliability. Interestingly, the test publisher utilized alpha coefficients to estimate reliability for several speeded measures (e.g., Planned Codes, Planned Connections, Planned Number Matching, Number Detection, and Receptive Attention). According to Nunnally and Bernstein (1994), coefficient alpha can overestimate more conservative measures (e.g., alternate-forms, split-half) of internal consistency for speeded measures. Average coefficients for the subtests are moderate to strong, ranging from .80 to .91. As would be expected, coefficients for the core battery (.86 to .95) and the extended battery (.90 to .97) composites are more robust than subtest coefficients. Average reliability coefficients for the supplemental composites are strong, ranging from .86 to .92. Internal consistency estimates were invariant across several demographic characteristics.

Temporal stability was assessed using a sample of 144 students who were administered the CAS2 twice, with a mean retest interval of 19 days. After testing was completed, the standard scores were correlated and corrected for range effects. Average test-retest coefficients were moderate to strong for the subtests (.73 to .85), and strong for the composites (.80 to .91). In order to estimate interrater reliability, two examiners from the test publisher independently examined 50 completed CAS2 protocols, randomly drawn from the normative sample. The obtained correlations between the examiners were also strong (.97 to .99) however; the scores that correspond to those reported coefficients are not described in the technical manual.

Validity

The CAS2 is intended to measure cognitive processing abilities, including attention, planning, executive functioning, working memory, and simultaneous and sequential processing. Validation of these measures was done through a multi-method examination of psychometric bias, internal structure, and external correlations with other psychoeducational measures.

Content Validity. Content validity was estimated by surveying the relevant technical literature to substantiate the use of the CAS2 subtests for each latent trait estimated by each measure. Additionally, differential item functioning analyses was conducted on individual items from the Matrices, Verbal-Spatial Relations, Figure Memory, Word Series, Sentence Repetition, Sentence Questions, and Visual Digit Span subtests. None of the analyzed items were found to be statistically biased across gender, race, and ethnicity.

Predictive Validity. Convergent and predictive validity were estimated by examining correlations between the CAS2 and a number of other measures, including commonly used measures of intellectual functioning and achievement. Overall conclusions indicate that the CAS2 scores correlated highly with instruments purported to measure similar neurocognitive

constructs. Of particular importance, scores on the CAS2 composites demonstrated high consistency with those from the CAS, with correlations ranging from .65 to .88. Predictive relationships between the CAS2 and various measures of achievement were commensurate with estimates obtained from other measures of intellectual functioning.

Developmental Evidence. An important consideration with assessments of cognitive abilities is the degree to which they accurately model expected developmental invariance in skills across the age span. The proportions of examinees that reported or were observed using a strategy on the Planning subtests reflected a linear increase in strategy use that is consistent with expected increases in executive functioning skills as children mature.

Construct Validity. In order to validate the four-factor PASS model, the test authors employed confirmatory factor analysis (CFA) procedures. According to the technical manual, the use of CFA procedures is preferred due to the fact that the measures on the CAS2 are theoretically derived. To assess factorial invariance, four CFA models were tested at separate age intervals (ages 5-7, 8-10, 11-13, and 14-18). Fit statistics suggest that a four-factor PASS model best fit the normative data across all of the age intervals. It should be noted that evidence for the structural validity of the supplemental composite scores was not provided in the technical manual.

Commentary and Recommendations

The CAS2 revision plan specified a number of specific goals including improving the reliability and validity of the measure, updating norms, as well as item modifications to diversify presentation formats across the measures. The test materials are of exceptional quality and administration of the CAS2 is relatively easy to master once users become familiar with the emphasis on strategy assessment for the Planning tests and the overall gestalt of the PASS theory

of cognitive functioning. Users of the previous edition will likely find the CAS2 to be a welcome addition to their testing library. Like its predecessor, the CAS2 is a unique clinical instrument, composed of novel measures, that remains one of the few alternatives for cognitive assessment professionals seeking an alternative to the Cattell-Horn-Carroll model of intellectual functioning (CHC).

Although the test authors acknowledge the vigorous debate in the technical literature regarding the construct validity of the previous edition, validity information presented in the technical manual is likely to raise similar concerns (e.g., Canivez, 2011; Kranzler & Keith, 1999) with the current instrument. While the test authors suggest that the PASS model best fit the normative data for the CAS2, the final structural model presented in the technical manual reflects a correlated factors model, not the hierarchical model suggested throughout test materials. Furthermore, in the final CFA validation model, subtest cross-loadings were constrained to zero which can lead to distorted structural relations when subtest cross-loadings loadings are nontrivial (Asparouhov & Muthen, 2009). Unfortunately the correlation matrices provided in the technical manual do not list correlations between subtests and composites, thus inferences regarding potential latent relationships cannot be made. However, several of the CAS2 subtests correlate significantly with measures outside of their specified composite. Additionally, the supplemental measures were not specified in any of the validation models therefore, the integrity of these measures is unknown.

Despite the psychometric shortcomings noted above, this present review of the CAS2 is largely positive. Perhaps the greatest strengths of the CAS2 are its potential clinical utility, with respect to diagnosing specific learning disability, and the fact that the information yielded by the instrument may aid in treatment planning (e.g., Naglieri & Pickering, 2010). Nevertheless, users

should interpret CAS2 scores cautiously until additional validity evidence is provided in the technical literature to document their integrity.

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