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Planning versus speed: an experimental examination of what Planned Codes of the Cognitive Assessment System measures

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Abstract

This study provided validity evidence that the Cognitive Assessment System, Planned Codes subtest measures planning rather than speed. Each of 156 children completed Planned Codes using two different sets of directions. The first set of directions allowed each child to use strategies to complete Planned Codes. The second set of directions allowed the child only to use speed to complete Planned Codes. The results of the study indicated significantly higher scores ($t = 11.5$, $P < .0001$) when the child was allowed to use strategies (mean = 34.1, S.D. = 9.2) compared to the same child's score when speed (mean = 25.6, S.D. = 7.5) alone was used to complete Planned Codes. A partial correlation, with age effects removed, between the scores each child earned under the two conditions was very low ($r = .23$; $P < .01$). Calculation of the magnitude of difference between the two groups yielded an effect size of 1.0. The results of this study provided validity support that the Cognitive Assessment System Planned Codes subtest measures planning.

Keywords: Planning versus speed; Cognitive Assessment System; Planned Codes

The Cognitive Assessment System (CAS; Naglieri & Das, 1997) is a measure of cognitive processing based on the planning, attention, simultaneous, and successive (PASS) model theory (Naglieri & Das, 1990; Das, Naglieri, & Kirby, 1994). According to this theory, human

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cognitive functioning includes four components. The first is planning processes that provide cognitive control, intentionality, and self-regulation to achieve a desired goal. The second is attentional processes that provide focused and selective cognitive activity over time. The third and fourth are simultaneous and successive information processes that are the two forms of operating on information. A small number of researchers have raised questions about the validity of the planning scale.

Carroll (1995) reviewed the book *Assessment of Cognitive Processes: The PASS Theory of Intelligence* (Das et al., 1994) and after re-analysis of data on CAS experimental tasks using factor analysis, concluded that the planning subtests were actually measures of speed.

Does the CAS planning scale measure planning as stated by Naglieri and Das (1997) or does the scale measure processing speed as suggested by Carroll (1995) and more recently by Kranzler and Keith (1999)? This question is too broad to be answered in one study and conclusions reached by factor analytic methods may miss important differences of subtests that comprise any scale. Therefore, the Planned Codes of the CAS Planning Scale was used in the present study for the following reasons. Planned Codes is the only subtest of the Planning Scale where the examiner can objectively record how a child completes it. The examiner must rely on verbal report from the child to determine how each of the other two subtests are completed.

Naglieri and Das (1997) defined planning as: ". . . a mental process by which the individual determines, selects, applies, and evaluates solutions to problems" (p. 2). This fits the completion of the CAS Planned Codes subtest because the directions clearly inform the child to decide how to complete the task. A second part of the directions of Planned Codes inform the child to complete it as fast as possible. Thus, the CAS Directions allow the individual to engage in cognitive activity about how to complete the task and work as rapidly as possible. The examiner can readily observe and record the result of the cognitive activity engaged in by the child because that decision is clearly identified by how the child completes the task.

Jensen recognized that time to complete a task and cognitive activity were important aspects of solving tasks. However, to measure pure speed, one must eliminate the cognitive activity in the timed task. "One can measure a speed factor in almost pure form only by divesting the timed task as completely as possible of any cognitive difficulty whatsoever" (Jensen, 1980, p. 136). By eliminating the cognitive activity, one measures speed in almost a pure form.

The present study used the CAS Planned Codes subtest for four reasons. First, cognitive activity on part of the child is involved completing the task. Second, the task is timed. These are identical to the position of Jensen. Third, an observer can readily see and objectively record how the child chooses to complete it. Fourth, Planned Codes becomes a simple clerical task when its speeded component is maintained but the decision on part of the child about how to complete it is removed. The child is told to complete it in a familiar manner thus removing the decision making about how it should be completed. Of course, the child still processes the directions but the cognitive burden of deciding how to complete it is not present. This results in a timed task devoid of most of the cognitive difficulty and thereby should become largely a measure of pure speed.

1. Method

1.1. Participants

The participants in this study were randomly selected by classroom from grades 3, 4, and 5 in a suburban elementary school in a large metropolitan area in the southwestern part of the United States. The children ranged in age from 7 to 11 years (S.D. = 10 months). There were 85 females (54%) and 71 males (46%). Seventy-seven percent of the participants had at least one parent who had a college degree. Sixteen percent had at least one parent who had some college. Four percent had at least one parent who had some kind of technical training after high school. Three percent had at least one parent who had graduated from high school or both parents who did not graduate from high school. White children composed 86% of the sample. Within the White portion of the sample, 14% of parents indicated a Hispanic background. Six percent of the children in the sample were Black, 7% were Asian, and 1% was American Indian or Alaskan Native.

1.2. Instrument

The CAS subtest Planned Codes contains four pages, two pages for item 1 and two pages for item 2. The first page of each item contains the sample and a row of practice items. The second page of each item contains seven rows and eight columns of letters without codes. A legend at the top of each page shows how letters (A, B, C, D) correspond to codes (OX, XX, OO, XO, respectively). Children fill in the appropriate codes in the empty boxes beneath each letter. In the first item, all the As appear in the first column, all the Bs in the second column, and so on. In the second item, the As, Bs, Cs, and Ds are configured diagonally.

1.3. Procedure

The Planned Codes subtest was group administered to children in each classroom by the author using two versions of directions. The first version is referred to as "CAS Directions" because the instructions followed those outlined in the CAS Manual but were adapted for group administration. This condition allowed children to complete the items in any manner they thought most efficient. The second condition was called "Speed Directions" because the children were instructed to complete the same Planned Codes items as quickly as possible from left to right, top to bottom, and one after the other without skipping. In order to ensure that children followed Speed Directions and did not choose a strategy the author and the classroom teacher walked around each classroom after directions were given to the children to ensure compliance with the directions. All of the children complied with the directions. Each child completed items 1 and 2 of Planned Codes with the directions being counter balanced by classroom.

1.3.1. Introductory instructions

These instructions were given first for both versions of directions. Look at these boxes at the top of the page. You see the letters A, B, C, and D. Each of the letters has an O and or X

in a certain order. Now look at the bottom of the page where you see the letters A, B, C, and D. There is nothing in the bottom of each. Fill in the correct code for each letter as is done at the top of the page.

1.3.2. CAS Directions

Look at this page. There are many boxes for you to fill in. Fill in as many of these as you can, as fast as you can, using the correct code for A, B, C, and D, as shown at the top of the page. You can do it any way you want. Let's see how many you can do as fast as you can. Remember, you can do it any way you want to. Ready? Begin. (Begin timing. After 60 s, say, "Stop," and collect the papers.)

1.3.3. Speed Directions

Look at this page. There are many boxes for you to fill in. Fill in as many of these as you can, as fast as you can, using the correct code for A, B, C, and D, as shown at the top of the page. Place your finger on the first box at the top left of the page. Move your finger across the top first row. When you get to the end of the first row, start at the left of the second row and complete them one after the other until the last one in that row, then start at the left in the third row and so on row by row, top to bottom. That is how you are to complete this page. Let's see how many you can do as fast as you can. Ready? Begin. (Begin timing. After 60 s, say, "Stop," and collect the papers.)

1.4. Data analyses

The score for each item was the number of correct codes in each item completed in 60 s. A paired *t* test with alpha set at .05 was used to compare the scores of the 156 children for the CAS Directions and the Speed Directions. The relationship among the scores for the two different directions was examined using Pearson Product–Moment correlation with the effects of age in months controlled by using a partial correlation (Guilford & Fruchter, 1978).

Effect size (ES) was computed using Cohen's *d* (Zakzanis, 2001). The corresponding overlap statistic (OL%) and nonoverlap statistic (Zakzanis, 2001) were utilized to further describe the ES.

1.5. Results

The mean score under the CAS Directions condition (34.1, S.D. = 9.2) was significantly higher than the mean score for the Speed Directions condition (25.6, S.D. = 7.5) for the 156 children, ($t(155) = 11.5$, $P < .0001$). The correlation coefficient between the scores, with age effects removed, from the different directions was small ($r = .23$; $P < .01$).

Cohen's *d* yielded an ES of 1.0. The OL% and nonoverlap statistic helped clarify the ES of 1.0. The ES of 1.0 was equal to an OL% of 44.6. This is the amount of overlap in the distribution of test scores between the two groups in this study. The nonoverlap percentage is 55.4 (100−44.6 = 55.4). When children had a choice about how to complete Planned Codes, 55.4% of those scores were higher than when the same children were told exactly how to complete the same subtest.

2. Discussion

The results of this study supported the position that Planned Codes measures planning. The reason children performed better under the CAS Directions condition was that it allowed children to develop and use strategies to complete the task. The low partial correlation coefficient between the scores the children earned under these two conditions supported the view that the CAS Directions and Speed Directions do not involve the same process. The ES found in this study was 1.0. This is considered to be a large ES using Cohen's heuristic benchmarks (Cohen, 1988).

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