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Correlation Between Intelligence Test Scores and Executive Function Measures

Alfredo Ardila

Miami Institute of Psychology

David Pineda

Neuropsychology Program, Department of Psychology, San Buenaventura University and Behavioral Neurology Program, School of Medicine, University of Antioquia

Mónica Rosselli

Florida Atlantic University

In this study, some executive function measures (Wisconsin Card Sorting Test [WCST], verbal fluency, and Trial Making Test [TMT], Form A and Form B) were correlated with Wechsler Intelligence Scale for Children-Revised (WISC-R) scores. Fifty 13- to 16-year-old normal children were selected. It was found that verbal fluency tests correlated about 0.30 with Verbal Intelligence Quotient (IQ) and Full Scale IQ. In the WCST only Perseverative Errors negatively correlated with Verbal IQ and Full Scale IQ. Two correlations were found to be significant with regard to the TMT: TMT Form B Errors negatively correlated with WISC-R Vocabulary subtest; and TMT Form A Time negatively correlated with Performance IQ. These results support the assumption that traditional intelligence tests are not appropriately evaluating executive functions. © 1999 National Academy of Neuropsychology. Published by Elsevier Science Ltd

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Prefrontal lobes activity has been associated with self-regulation, control of cognition (metacognition), temporal organization of behavior, monitoring of behavior, selective inhibition of responses to immediate stimuli, planning behavior, and control of attention (Brown, 1985; Damasio & Anderson, 1993; Fuster, 1989; Hécaen, 1964; Luria, 1966, 1969, 1973, 1980; Percecman, 1987; Pribram, 1973; Stuss & Benson, 1983, 1986, 1987). The name *executive function* has been proposed to refer to the multi-operational system mediated by prefrontal areas of the brain and their reciprocal cortical and subcortical connecting pathways (Stuss & Benson, 1986). Executive dysfunction may be summarized in two cardinal defects: controlling behavior and organizing cognition.

For a long time it has been noted that frontal damage does not result in evident deficits in psychometric intelligence tests (Hebb, 1939; Hebb & Penfield, 1940). This is true even in cases of bilateral frontal lobectomy. It was somehow surprising to find that intelligence quotient (IQ) in patients with frontal lobe damage could be normal (Hebb, 1945). These initial observations carried out during the 1940s have been further well-documented in neuropsychology (e.g., Brazzelli, Colombo, Della Sala, & Spinnler, 1994; Damasio & Anderson, 1993). Milner (1983), for instance, reported a mean loss of only 7.2 IQ points following dorsolateral frontal lobectomies, with mean postoperative IQ scores remaining in the average range. More recently, Damasio and Anderson (1993) analyzed 10 patients with ventrolateral and dorsolateral frontal lesions that were caused by either vascular events or surgical resection for treatment of tumors. The most notable feature of the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981) testing in these patients was the consistent preservation of the cognitive abilities required to perform the various intellectual tasks following frontal lobe damage. This observation means that psychometric intelligence tests are not sensitive to frontal lobe deficits ("executive dysfunctions").

Very few studies have analyzed the association between executive function measures and psychometric intelligence test scores. Welsh, Pennington, and Groisser (1991) observed in children that most of the executive function tasks (Visual Search [Teuber, Battersby, & Bender, 1955]; Verbal Fluency [McCarthy, 1972]; Motor Planning [Golden, 1981]; Tower of Hanoi [Simon, 1975]; Wisconsin Card Sorting Test [WCST; Heaton, 1981]; and Matching Familiar Figures Test [Kagan, 1964]) were uncorrelated with IQ. Visual Search, Verbal Fluency, WCST, and Tower of Hanoi did not correlate with any IQ measure (Verbal, Quantitative, and Nonverbal) from the Iowa Test of Basic Abilities. Using a 300-subject college-student sample, Ardila, Galeano, and Rosselli (1998) observed that Verbal Fluency tests presented a low but significant correlation (0.20–0.25) with some WAIS verbal subtests, particularly Digits, Arithmetic, and Information. However, WCST scores did not correlate at all with the Verbal, Performance, or Full Scale IQ. The independence of executive functions from psychometric intelligence may be conjectured.

The purpose of this research was to analyze the association between executive function measures and psychometric intelligence test scores in adolescents. This study represents a secondary analysis of the data collected in the norming study of some neuropsychological tests carried out in Colombia, using a Spanish-speaking population.

METHOD

Participants

Fifty 13- to 16-year-old male children ($M = 14.38$; $SD = 1.02$) were taken. Children were selected from the public schools of Medellín city (Colombia, population about 2 million). All children were monolingual native Spanish speakers. Their mean school level was 8.66 years ($SD = 1.22$; range = 7–10). They voluntarily agreed to participate with the purpose of obtaining norms for some psychological and neuropsychological tests. All of the subjects were in a low socioeconomic status.

Testing was performed by graduate neuropsychology students from San Buenaventura University, under the supervision of a professor. Evaluation was performed in three sessions, each one lasting about 40 minutes. Tests were administered in the following sequence: Wechsler Intelligence Scale for Children-Revised, Spanish version (WISC-R;

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