

BLOCK DESIGN AS A MEASURE OF EVERYDAY SPATIAL
ABILITY: A STUDY OF ECOLOGICAL VALIDITY

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Summary.—This study investigated the effectiveness of the WAIS-R Block Design subtest to predict everyday spatial ability for 65 university undergraduates (15 men, 50 women) who were administered Block Design, the Standardized Road Map Test of Direction Sense, and the Everyday Spatial Activities Test. In addition, the verbally loaded National Adult Reading Test was administered to assess whether the more visuospatial Block Design subtest was a better predictor of spatial ability. Moderate support was found. When age and sex were accounted for, Block Design accounted for 36% of the variance in performance ($r = -.62$) on the Road Map Test and 19% of the variance on the performance of the Everyday Spatial Activities Test ($r = .42$). In contrast, the scores on the National Adult Reading Test did not predict performance on the Road Map Test or Everyday Spatial Abilities Test. This suggests that, with appropriate caution, Block Design could be used as a measure of everyday spatial abilities.

Considerable controversy has surrounded the interpretation of WAIS-R subtests. Lezak (1988, 1995), for example, recommended that subtest profiles be interpreted because this is theoretically consistent with the multidimensionality of intelligence, provides information on a range of a client's abilities, and is useful in making inferences about competencies in the real world. Most authors who advocate interpretation of subtests caution that appropriate hypothesis testing needs to be conducted (Kaufman, 1990, 1994; Groth-Marnat, 1999; Groth-Marnat, Gallagher, Hale, & Kaplan, 2000). In contrast McDermott, Glutting, Jones, and Noonan (1989) and McDermott, Fantuzzo, and Glutting (1990) have discouraged such interpretation on the grounds that the reliabilities of the subtests are too low, insufficient validation has been conducted, and the subtests are too heterogeneous.

The above suggests that further research needs to be conducted on the validity of Wechsler intelligence scale subtests. Since clinicians must make predictions related to a client's everyday functioning, this research should ideally be focused on understanding the relationships between subtest scores and relevant everyday behavior. The Block Design subtest, in particular, has frequently been used to make inferences regarding visuospatial ability (Kaufman, 1990, 1994; Lezak, 1995; Groth-Marnat, 1999; Groth-Marnat, *et al.*,

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2000). Despite frequent use, there has been very little research to establish its ecological validity. The two studies which have been conducted were done 30 years ago and focused on self-care among neurologically impaired patients (Lorenze, Cancro, & Sokoloff, 1961; Lorenze & Cancro, 1962). The current study provides more recent assessment of the everyday validity of scores on the Block Design using a normal, university population.

METHOD

Participants and Procedure

Sixty-five undergraduate university students (18–25 years, $M=24.8$, $SD=7.6$, 15 men and 50 women) were administered Block Design (Wechsler, 1981), Standardized Road Map Test of Direction Sense (Money, 1976), Everyday Spatial Activities Test (Lunnenborg & Lunnenborg, 1986), and the National Adult Reading Test (Nelson, 1982).

Materials

Block Design.—Block Design is a visuospatial problem-solving subtest of the Wechsler Adult Intelligence Scales–Revised (Wechsler, 1981). It is reliable (split-half $r = .85$) and correlates highly with general intelligence (53% of its variance can be attributed to g ; Wechsler, 1981).

Money Road Map Test.—This is an untimed, individually administered measure of visuospatial right–left discriminative ability (Money, 1976). The participants are given a map marked with a specific route. Without reorienting the map, the subject must tell the examiner whether he would turn right or left at each of 32 possible corners. Thus it is not so much a measure of overall visuospatial abilities as of a subset of visuospatial abilities related to right–left discrimination. Construct validity is supported in that it can discriminate persons with various scores on spatial rotation and lower scores have been found among subjects with neuropsychological disorders in the right hemisphere (Vingerhoets, Lannoo, & Bauwens, 1996).

Everyday Spatial Activities Test.—This test by Lunnenborg and Lunnenborg (1986) is a 20-item self-report questionnaire designed to identify various types of spatial abilities for college students. In the present sample, test-retest reliability over a 2-wk. interval was .83. Lunnenborg and Lunnenborg (1986) reported that validity of the test is supported based on careful selection of item content, factor analysis, and weak correlations between external criterion measures of spatial abilities, .35 for men and .32 for women (Lunnenborg & Lunnenborg, 1986).

National Adult Reading Test.—Developed by Nelson (1982), this test is comprised of 50 phonetically irregular words that can only be pronounced by someone who is familiar with them. The split-half reliability was .90, test-retest reliability .98, and interrater reliability .96 (Crawford, 1992). The Na-

tional Adult Reading Test correlated .72 with the WAIS-R Full Scale IQ and loaded .85 on *g* (Crawford, 1992). Conceptually the National Adult Reading Test assesses primarily verbal abilities; this is empirically supported by the higher correlation with the WAIS-R Verbal IQ ($r = .85$) than Performance IQ ($r = .33$; Crawford, 1992).

RESULTS

Table 1 summarizes the means and standard deviations for all variables. Hierarchical multiple regression was used to examine the effectiveness of Block Design, the National Adult Reading Test, age, and sex to predict performance on the Road Map Test. When age and sex were accounted for,

TABLE 1
MEANS AND STANDARD DEVIATIONS FOR ALL VARIABLES

Variable	<i>M</i>	<i>SD</i>
Age	24.78	7.57
Block Design	11.68	2.69
National Adult Reading Test	19.22	6.49
Road-Map Test	2.92	2.82
Everyday Spatial Activities	62.54	13.30

scores on Block Design uniquely accounted for 36% of the variance in Road Map Test performance (see Table 2). The correlation between scores on Block Design and the Road Map Test was $-.62$ ($p < .001$). In contrast, age, sex, and scores on the National Adult Reading Test did not account for a significant proportion of the variance. A second hierarchical multiple regression assessed the extent to which Block Design, the National Adult Reading

TABLE 2
HIERARCHICAL REGRESSION OF SEX, AGE, BLOCK DESIGN, AND PERFORMANCE
ON NATIONAL ADULT READING TEST AND ROAD MAP TEST SCORES

	<i>R</i> ²	<i>R</i> ² Change	<i>p</i>
Step 1 (Sex + Age)	.05	.05	.05
Step 2 (Sex + Age + Block Design)	.41	.36	.001
Step 3 (Sex + Age + Block Design + NART)	.43	.02	.05

Test, age, and sex predicted performance on the Everyday Spatial Activities Test scores. When age and sex were accounted for, Block Design uniquely accounted for 19% of the variance of performance on the Everyday Spatial Activities Test (see Table 3). The correlation between these scores and those on the Everyday Spatial Activities Test was $.42$ ($p < .001$). In contrast, scores on the National Adult Reading Test did not significantly predict Everyday Spatial Activities Test performance, and age and sex combined accounted

TABLE 3
 HIERARCHICAL REGRESSION OF SEX, AGE, BLOCK DESIGN, AND PERFORMANCE
 ON NATIONAL ADULT READING TEST ON EVERYDAY SPATIAL ACTIVITIES TEST SCORES

	R ²	R ² Change	p
Step 1 (Sex + Age)	.10	.10	.05
Step 2 (Age + Block Design)	.30	.19	.001
Step 3 (Age + Block Design + NART)	.30	.01	.05

for 10% of the variance on the Everyday Spatial Activities Test. Scores on the Road Map Test and the Everyday Spatial Activities Test correlated $-.30$ ($p < .01$), as expected since Road Map Test scores are for errors or weaknesses whereas the Everyday Spatial Activities Test is scored for abilities or strengths.

DISCUSSION

Moderate support was found for the effectiveness of Block Design to predict everyday spatial measures. This was supported by moderate correlations with two measures of everyday spatial abilities and a significant proportion of the unique variance was accounted for (36% and 19%) when Block Design was used as a predictor and age and sex were controlled statistically. In addition, the more spatially oriented Block Design subtest accounted for a larger proportion of the variance related to everyday spatial abilities than the primarily verbal National Adult Reading Test.

The above findings provide some support for the continued use of Block Design as a test of everyday spatial ability; however, it should also be stressed that a large proportion of the variance in everyday spatial abilities was still not accounted for. This is most likely due in part to the influence of other more general abilities contributing to Block Design performance. These might include concentration, speed of information processing, and motor coordination. This is consistent with previous analysis indicating that 53% of Block Design can be accounted for by g rather than more specific (visuospatial) abilities (Kaufman, 1990). A further issue is that, even though Block Design is a fairly reliable subtest (.85; Wechsler, 1981), there is still error due to less than perfect reliability. The above underscores the importance of carefully searching for additional support when inferences related to visuospatial abilities are made based on Block Design scores.

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