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# Research Brief

## **Relations Between Executive Function Measures and Measures of the *g* Factor**

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# Relations Between Executive Function Measures and Measures of the *g* Factor

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## Introduction

This study examined relationships among select executive function measures from the Delis–Kaplan Executive Function System (DKEFS) and measures of the *g* factor derived from the Woodcock-Johnson III (WJ III) Tests of Cognitive Abilities (COG), a battery of tests based on the Cattell–Horn–Carroll theory of intelligence.

## Method

### Participants

**Child sample.** The child sample for this study comprised 100 children (49 boys and 51 girls) in regular education classrooms. Participants ranged in age from 8 to 18 years ( $M = 10.7$ ,  $SD = 2.5$ ). Approximately 83% of the sample were White, 14% were Black, and 3% were Asian.

**Adult sample.** The adult sample for this study comprised 102 non-referred adults (28 males, 73 females, 1 no response) enrolled in 4-year universities. Participants ranged in age from 18 to 51 years ( $M = 23.3$ ,  $SD = 6.4$ ). Approximately 72% of the sample were White, 25% were Black, and 3% were Asian.

### Procedures and Measures

All participants completed 18 tests from the WJ III COG and 8 subtests from the DKEFS. Both test batteries were administered in a counterbalanced order and scored according to age-based norms. Two factor analyses were conducted to examine the relations between the latent *g* factor and the DKEFS scores considered the purest measures of executive function (EFs). All 18 test scores from the WJ III COG and 12 scores derived from the 8 DKEFS tests were used in these analyses. The DKEFS scores included the following:

- **Word Context:** Examinees must discover the meaning of a made-up word based on its use in five sentences.
- **Sorting:** Examinee must sort sets of six cards into as many different categorization rules as possible (*Free Sorting Confirmed Correct*). Examinees must describe the concepts that the examiner used to generate each sort (*Sort Recognition Description*).
- **Color-Word Interference: Inhibition:** Examinees must inhibit reading words denoting colors while naming the colors themselves. **Twenty Questions:** Examinees must ask yes/no questions to identify a target object from a set of common objects.
- **Verbal Fluency:** Examinees must rapidly generate words, according to letter (*Letter Fluency*), category (*Category Fluency*), or must alternate between two different semantic categories (*Total Correct Responses* and *Total Switching Accuracy*).
- **Trail Making: Number-Letter Switching:** Examinees must switch back and forth between connecting numbers and letters in sequence in a timed administration.
- **Design Fluency:** Examinees must draw as many designs as possible following a set of rules (*Filled Dots*). Examinees must draw as many designs as possible alternating connections between filled and empty dots (*Switching*).
- **Twenty Questions:** Examinees must ask yes/no questions to identify a target object from a set of common objects.
- **Tower:** Examinees must move disks varying in size across three pegs to build a designated tower using the fewest number of moves possible.

For each sample, scores from all DKEFS conditions across the 8 subtests were also correlated with the General Intellectual Ability-Extended (GIA-Ext) score from the WJ III COG. The GIA-Ext is based on performance on 14 tests that are differentially weighted based on their loadings on the first principal component from a factor analysis at each age level. The GIA-Ext can be considered an IQ and a measure of general intelligence.

## Results and Discussion

### DKEFS Score *g* Loadings

All missing data were estimated using the EM algorithm (Shafer, 1999). For each sample, the 18 WJ III scores and the 12 DKEFS scores were entered into a factor analysis and a single principal component was extracted. The loadings on the first principal component can be considered *g* loadings, and they represent the correlation between individual scores and the component that represents general intelligence (*g*; Jensen, 1998). Results indicated that the principal component accounted for 31.1% and 28.3% of the shared variance among the 30 scores for the child sample and the adult sample, respectively. The table below presents the *g* loadings for the DKEFS scores. (WJ III test *g* loadings are not presented.) The Word Context: Total Consecutively Correct score demonstrated the strongest relations with the *g* factor, and the Tower: Total Achievement score demonstrated the lowest. Only the Word Context: Total Consecutively Correct score demonstrated *g* loadings that can be considered strong based on traditional psychometric standards (above .70; Kaufman, 1994). The average *g* loading for the child sample was .54, and the average *g* loading for the adult sample was .42. For the child sample, nine *g* loadings can be considered fair measures of *g*, and two can be considered poor. For the adult sample, three *g* loadings can be considered fair measures of *g*, and eight can be considered poor.

DKEFS score	<i>g</i> loading for child sample	<i>g</i> loading for adult sample
Word Context: Total Consecutively Correct	.70	.76
Sorting: Sort Recognition Description	.63	.63
Color-Word Interference: Inhibition	.61	.27
Verbal Fluency: Letter Fluency	.60	.31
Trail Making: Number-Letter Switching	.59	.54
Sorting: Free Sorting Confirmed Correct	.58	.64
Design Fluency: Filled Dots	.57	.32
Verbal Fluency: Category Fluency	.55	.35
Twenty Questions: Total Achievement	.54	.11
Design Fluency: Switching	.52	.40
Verbal Fluency Category Switching: Switching Accuracy	.46	.34
Tower: Total Achievement	.17	.35

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### Relations between DKEFS Scores and WJ III GIA-Ext

All Pearson correlations between the GIA-Ext and the DKEFS scores (across all conditions of the subtests) were statistically significant at the .001 level with the exception of the Tower: Total Achievement. Significant correlations ranged from .23 (Verbal Fluency Category Switching: Switching Accuracy) to .68 (Word Context). Consistent with *g* loadings, the Word Context: Total Consecutively Correct score demonstrated the strongest relations for both samples. For the child sample, only Tower: Total Achievement demonstrated nonsignificant relations. However, for the adult sample, Trail Making: Visual Scanning, Trail Making: Number Sequencing, Trail Making: Motor Speed, Color-Word Interference: Color Naming, Color-Word Interference: Word Reading, Color-Word Interference: Inhibition, Twenty Questions: Total Questions, and Twenty Questions: Total Achievement demonstrated nonsignificant relations. It is possible that restriction of range lead to attenuation of these correlations and the associated *g* loadings—especially for the adult sample.

DKEFS score	Correlation with WJ III GIA-Ext for child sample	Correlation with WJ III GIA-Ext for adult sample
Trail Making: Visual Scanning	0.33**	0.02
Trail Making: Number Sequencing	0.54**	0.11
Trail Making: Letter Sequencing	0.48**	0.34**
Trail Making: Number-Letter Switching	0.54**	0.41**
Trail Making: Motor Speed	0.40**	0.03
Verbal Fluency: Letter Fluency	0.48**	0.29*
Verbal Fluency: Category Fluency	0.43**	0.27*
Verbal Fluency Category Switching: Correct Responses	0.46**	0.27*
Verbal Fluency Category Switching: Switching Accuracy	0.41**	0.31*
Design Fluency: Filled Dots	0.45**	0.23*
Design Fluency: Empty Dots	0.42**	0.24*
Design Fluency: Switching	0.42**	0.29*
Design Fluency: Total	0.50**	0.31*
Color-Word Interference: Color Naming	0.40**	0.00
Color-Word Interference: Word Reading	0.45**	0.02
Color-Word Interference: Inhibition	0.52**	0.18
Color-Word Interference: Inhibition/Switching	0.48**	0.27*
Sorting: Free Sorting Confirmed Correct	0.50**	0.55**
Sorting: Free Sorting Description	0.52**	0.53**
Sorting: Sort Recognition Description	0.54**	0.55**
Twenty Questions: Initial Abstraction	0.49**	0.40**
Twenty Questions: Total Questions	0.50**	0.14
Twenty Questions: Total Achievement	0.48**	0.10
Word Context: Total Consecutively Correct	0.68**	0.68**
Tower: Total Achievement	0.16	0.33**

Note. \* =  $p < .05$ , \*\* =  $p < .001$ .