

Increased Variability in Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV) Performance Across Adulthood



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Introduction

Multiple domains of cognitive functioning, as measured by the WAIS-III (Wechsler, 1997), are profoundly impacted by advancing age while others remain relatively stable. More specifically, normal aging is classically associated with a linear decline in performance on the WAIS-III non-verbal (“fluid”) tasks while verbal (“crystallized”) abilities typically remain static or even show improvement (Cattell, 1963; Ryan, Sattler, & Lopez, 2000). Focusing exclusively on the mean scores of these measures, however, does not fully capture the pattern of decline. For example, a standard deviation score 5 represents little variance when the mean is 50, but a significant amount of variance when the mean is 10. As a result, recent analyses of the relationship between mean and standard deviation scores from the WAIS-III normative manual have found increasing *Percentage of the Mean* scores with age on measures of fluid intelligence (i.e. executive functioning and attention; Ardila, 2007). The most recent iteration of the WAIS (Wechsler, 2008) has introduced a number of new subtests and now de-emphasizes the traditional crystallized/fluid dichotomy of intelligence. As a result, the purpose of this study was to examine the score dispersions, particularly the percentage of the mean, in different WAIS-IV subtests at different ages.

Sample Characteristics

Norms presented in the Administration and Scoring Manual (Wechsler, 2008) were used. The WAIS-IV was standardized using 2,200 examinees divided into 13 age groups: 16-17, 18-19, 20-24, 25-29, 30-34, 35-44, 45-54, 55-64, 65-69, 70-74, 75-79, 80-84, and 85-90. The ratio of different ethnicities and gender were proportionally consistent with census data. The sample was drawn from four different geographical regions in the United States (West, Midwest, South, & Northeast) and stratified according to 5 education levels based on number of years of school completed: ≤ 8 , 9-11, 12, 13-15, and ≥ 16 . A detailed description of the sample, including education at the different age ranges, can be found in the WAIS-IV Technical and Interpretive Manual.

Method

Raw WAIS-IV subtest means and standard deviations for each age group were calculated from the normative information presented in the WAIS-IV manual. Raw scores corresponding to a scaled score 10 were considered as the mean. Raw scores corresponding to scaled score equal to 7 and 13 (i.e., plus and minus 1 standard deviation) were used to calculate the raw standard deviation within each subtest for each age group. Finally, the *Percentage of the Mean* was calculated by dividing the standard deviation by the mean and multiplying by 100. This coefficient of variation (CV) statistic represents the heterogeneity and dispersion of the scores (Ardila, 2007).

Verbal Comprehension Index by Age

Subtest	Age Group		
	16-17	55-64	85-89
<u>Similarities</u>			
Mean	23.0	25.5	20.5
S.D.	5.3	6.0	6.3
% of mean	22.8	23.5	30.5
<u>Vocabulary</u>			
Mean	30.0	38.5	33.0
S.D.	10.3	11.8	12.5
% of mean	34.2	30.5	37.9
<u>Information</u>			
Mean	13.0	14.5	11.5
S.D.	4.8	5.8	5.8
% of mean	36.5	39.7	50.0
<u>Comprehension</u>			
Mean	22.5	24.5	19.5
S.D.	5.8	6.3	6.3
% of mean	25.6	25.5	32.1

Perceptual Reasoning Index by Age

Subtest	Age Group		
	16-17	55-64	85-89
<u>Block Design</u>			
Mean	46.5	35.5	22.0
S.D.	12.5	12.3	9.3
% of mean	26.9	34.5	42.0
<u>Matrix Reasoning</u>			
Mean	19.0	15.0	8.0
S.D.	4.5	4.8	3.8
% of mean	23.7	31.7	46.9
<u>Picture Completion</u>			
Mean	14.0	12.0	7.0
S.D.	3.8	4.0	3.5
% of mean	26.8	33.3	50.0
<u>Visual Puzzles</u>			
Mean	16.5	13.0	8.0
S.D.	5.3	3.8	2.5
% of mean	31.8	28.8	31.3
<u>Figure Weights</u>			
Mean	16.5	12.0	N/A
S.D.	5.3	4.0	N/A
% of mean	31.8	33.3	N/A

Working Memory Index by Age

Subtest	Age Group		
	16-17	55-64	85-89
<u>Digit Span Forward</u>			
Mean	10.5	10.0	9.0
S.D.	2.0	2.8	2.0
% of mean	19.0	27.5	22.2
<u>Digit Span Backward</u>			
Mean	7.5	8.0	6.5
S.D.	2.5	2.5	1.8
% of mean	33.3	31.3	26.9
<u>Digit Span Seq.</u>			
Mean	9.0	8.0	6.0
S.D.	2.0	2.3	2.5
% of mean	22.2	28.1	41.7
<u>Arithmetic</u>			
Mean	13.5	14.0	11.0
S.D.	3.8	3.8	3.3
% of mean	27.8	26.8	29.5
<u>Letter-Number Seq.</u>			
Mean	20.5	20.0	N/A
S.D.	3.8	4.0	N/A
% of mean	18.3	20.0	N/A

Processing Speed Index by Age

Subtest	Age Group		
	16-17	55-64	85-89
<u>Coding</u>			
Mean	73.0	59.5	34.0
S.D.	16.8	15.5	15.0
% of mean	22.9	26.1	44.1
<u>Symbol Search</u>			
Mean	34.5	28.0	15.5
S.D.	8.0	7.5	6.5
% of mean	23.2	26.8	41.9
<u>Cancellation</u>			
Mean	42.0	37.0	N/A
S.D.	9.8	9.5	N/A
% of mean	23.2	25.7	N/A

Results

Consistent with much of the prior research, raw mean scores predictably decreased across age groups. Increased variability was noted in Perceptual Reasoning (PRI) and Processing Speed (PSI) indices, as Block Design, Matrix Reasoning, Picture Completion, Symbol Search, and Coding had percentage of the mean increases ranging from 56 - 100%. In contrast, Working Memory (WMI) and Verbal Comprehension (VCI) indices were more homogeneous with Digit Span, Comprehension, Information, and Similarities percentage of the mean increases ranging from 28 - 39%. Little change in the percentage of the mean was noted on Cancellation, Arithmetic, Letter/Number Sequencing, Figure Weights, Visual Puzzles, and Vocabulary subtests (< 13%).

Discussion

Normal WAIS-IV performance relative to average normative scores alone can be an oversimplification as this fails to recognize disparate subtest heterogeneity with increases in age. A thorough understanding of age related subtest variability will help to identify test limitations as well as furthering our understanding of cognitive domains which remain relatively steady versus those which steadily decline.