Applied H.R.M. Research, 2004, Volume 9, Number 1, pages 27-30

Validity Study

Longitudinal Study of the Validity of Different Cognitive Ability Tests in a Student Admission Context

Filip Lievens
Ghent University

This study examines the criterion-related validity of four types of cognitive ability tests in an operational student admission context over a three year follow-up period. Nine-hundred forty-one candidates completed a general measure of cognitive ability and three specific tests, namely a visual information processing test, a memory association test, and a pattern recognition test. The criterion was GPA at the end of the first three academic years of medical study. Results showed that the general mental ability test was a significant predictor of GPA in each of successive academic years, whereas the three specific cognitive ability tests did not emerge as consistent predictors. None of these specific tests explained incremental variance over and above the general measure of cognitive ability.

Sample

N	941 candidates of an admission exam
Gender	359 men and 582 women
Race	99.5% were White
Age	18.3 years

Location

The data for this study were collected during the Admission Exam 'Medical and Dental Studies' in the Flemish part of Belgium (July, 1997).

Predictor information

Four cognitive ability tests were used. First, a general cognitive ability measure consisted of 54 items with five response alternatives. There were three types of problems in this test: verbal, numeric, or diagrammatic. Prior research demonstrated good reliability and predictive validity of this reasoning test for medical students (Minnaert & Janssen, 1998).

In addition to this general measure, three specific cognitive ability tests were used: a visual information processing test, a memory association test, and a pattern recognition test. The visual information processing test (32 items) measured the ability to quickly scan and interpret complex figures. In the memory association test, characteristics of 15 patients (i.e., name, age, job title, type of illness) had to be memorized. The reproduction phase (which took place upon completion of the general cognitive ability test) contained 20 questions dealing with these patient descriptions. Finally, the pattern recognition test measured the cognitive ability to determine which simple figure was part of a complex figure. In particular, 50 complex figures were included and per complex figure, five possible simple figures were presented. For test security reasons, we

cannot mention the source of these cognitive ability tests. Interested researchers may contact the author to obtain more information.

Table 1 presents descriptive information on these predictors on the basis of the full sample (N = 941). As can be seen, all predictors had adequate internal consistency coefficients. As was expected, the measure of general mental ability had a somewhat lower internal consistency coefficient because of its more heterogeneous item content (see above). Correlations among the predictors were as expected. For example, the measure of general mental ability significantly correlated with the three specific tests. There was also a significant correlation between the visual information processing test and pattern recognition test.

Table 2 breaks down predictor scores by gender. Men slightly outperformed women on the general cognitive ability test (d = .12). Gender differences on specific tests were consistent with prior research on mental ability testing (Jensen, 1998). Men scored higher on visualization and pattern recognition, whereas women scored higher on memory tasks.

Table 1

Means, Standard Deviations, and Reliabilities of Predictors in Full Sample (N = 941)

	M	*SD*	1.	2.	3.	4.
1. General mental ability	27.76	5.75	(.61)			
2. Visual information processing	12.13	5.16	.28**	(.81)		
3. Memory association	9.64	3.71	.25**	.04	(.71)	
4. Pattern recognition	24.33	10.52	.30**	.31**	.09**	(.95)

**p < .01.

Internal consistency coefficients are on the diagonal

Table 2

Gender Differences on Predictors

	Males (N = 356)		Females (N = 585)		
	M	*SD*	*M*	*SD*	*d*
1. General mental ability	28.18	6.14	27.51	5.49	.12
2. Visual information processing	13.06	5.27	11.56	5.01	.29
3. Memory association	8.99	3.77	10.03	3.63	-.28
4. Pattern recognition	25.13	10.35	23.83	10.61	.12

The d values are effect sizes computed by $(M_{\text{Males}} - M_{\text{Females}}) / SD_{\text{Overall}}$

Criterion Information

The criterion was GPA at the end of the first three academic years of medical study. This three-year time span conforms to the so-called pre-clinical years in medical education in Belgium. Criterion data were gathered from all Belgian universities. Given differences across universities, we standardized students' GPA within university and within academic year (by subtracting the student's average from the university average and dividing this by the university standard deviation). GPA correlated strongly across years, with correlations between GPA varying between .69 and .72 (see Table 3).

Validity Information

Table 3 presents the uncorrected validity coefficients. However, the restricted standard deviations of all predictors are also given so that the corrected validity coefficients can be easily computed. Table 3 shows that the measure of general mental ability was a significant predictor of GPA in each of the three academic years. The three specific tests did not emerge as consistent predictors, even though prior studies (e.g., Patel, Groen, & Frederiksen, 1986; Wilson & Suddick, 1980; Wilson, Suddick, Shay, & Hustmyer, 1981) had identified these specific cognitive factors as possible determinants of GPA in pre-clinical medical performance.

We also examined whether the specific tests accounted for incremental variance over and above the measure of general mental ability. In none of these regressions did the specific tests explained incremental variance over *g*. These results conform to prior research (Ree & Earles, 1991; Ree, Earles, & Teachout, 1994).

Table 3
Intercorrelations among Predictors and Criteria in Selected Sample (N = 361)

	M	*SD*	1.	2.	3.	4.	5.	6.
Predictors								
1. General mental ability	29.79	5.25	--					
2. Visual information processing	12.08	4.85	.15**	--				
3. Memory association	10.09	3.73	.16**	-.03	--			
4. Pattern recognition	26.39	10.62	.20**	.25**	.03	--		
Criteria								
5. GPA year 1	.64	.53	.29**	.02	.08	.12*	--	
6. GPA year 2	.21	.77	.16**	.04	.07	.06	.69**	--
7. GPA year 3	.03	.99	.20**	.05	.15**	.03	.64**	.72**

*$p < .05$; **$p < .01$.

References

Jensen, A.R. (1998). *The g factor: The science of mental ability*. Westport, CT: Praeger.

Minnaert, A., & Janssen, P.J. (1998). The additive effect of regulatory activities on top of intelligence in relation to academic performance in higher education. *Learning and Instruction,* 9, 77-91.

Patel, V.L., Groen, G.J., & Frederiksen, C.H. (1986). Differences between medical students and doctors in memory for clinical cases. *Medical Education, 20,* 3-9.

Ree, M. J., Earles, J. A., & Teachout, M. S. (1994). Predicting job performance: Not much more than g. *Journal of Applied Psychology, 79,* 518-524.

Ree, M. J., & Earles, J. A. (1991). Predicting training success: Not much more than g. *Personnel Psychology, 44,* 321-332.

Wilson, S., & Suddick, R.P. (1980). Embedded figures and inverted star tracing tests of dental students related to preclinical technique grades and DAT-PMAT scores. *Journal of Dental Education, 44,* 44.

Wilson, S., Suddick, R.P., Shay, J.S., & Hustmyer, F.E. (1981). Correlation of scores on embedded figures and mirror tracing with preclinical technique grades and PMAT scores of dental students. *Perceptual and Motor Skills, 53,* 31-35.

Questions about this validity study should be addressed to:

Filip Lievens, Ph.D.
Dept. of Personnel Management and Work and Organizational Psychology
Ghent University
Henri Dunantlaan 2
9000 Ghent
Belgium
filip.lievens@ugent.be