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A Study of the Standard Progressive Matrices Plus in Cambodia

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Data are reported for the Standard Progressive Matrices Plus, applied to a sample of 1641 male and 1441 female school students aged 6 to 18 years old in Cambodia. Scores were higher than those recorded in earlier studies of non-verbal intelligence in Cambodia, indicating an average IQ near 100. There were no consistent gender differences. In addition to age and school grade, numbers of brothers and sisters were associated with test scores. Family income had virtually no relationship with test scores.
Key Words: Intelligence; Standard Progressive Matrices Plus; IQ meritocracy; Family structure; Cambodia

Little is known about average cognitive abilities in Cambodia. Early studies indicated lower scores on standardized tests relative to neighboring countries, especially Thailand and Vietnam. The first published study of intelligence in Cambodia was performed in the early 1990s with students from two institutions of higher education: the Institute of Economic Studies in Phnom Penh, and Maharishi Vedic University in the eastern province of Prey Veng. This study used the Cattell Culture Fair test and found low scores scaled to IQs between 67 and 81 for different groups and test applications (Fergusson, Bonshek & Le Masson, 1995). A more recent study investigated spatial abilities with tests of mental rotation and cube comparison. It compared students at Phnom Penh University,

average age 19 years, with similar-aged students in secondary and tertiary education in Germany. The result was a difference of 1.57 standard deviations on mental rotation and 0.99 standard deviations on cube comparison favoring the German students (Janssen & Geiser, 2012).

These results, showing rather low scores for Cambodian students, are corroborated by studies on the performance of Cambodian school children on standardized achievement tests in the United States. In one such study, the children of Cambodian refugees scored at the 14th percentile on a reading test and the 35th percentile on a math test, whereas the children of Vietnamese refugees scored at the 37th percentile on reading and the 60th percentile on math (Kim, 2002). Cognitive test scores in Vietnam, with which Cambodia is often compared, have risen to levels similar to those in Western countries in recent years, both on IQ tests (Rindermann, Hoang & Baumeister, 2013) and on the PISA tests of scholastic achievement (oecd.org/pisa).

The present study uses the Standard Progressive Matrices (SPM), a test of abstract non-verbal reasoning ability, in an effort to further examine cognitive development in Cambodia, and specifically to estimate whether cognitive test performance has improved in recent years.

Method

The Standard Progressive Matrices is a non-verbal reasoning test developed in Britain in the 1930s that has been used extensively during the last eighty years. The Standard Progressive Matrices Plus (SPM+) is a more difficult version of the test standardized in Britain in 2007/08 (Raven, 2008). The Raven tests are the most widely used cognitive tests for cross-cultural studies because of their non-verbal nature and their presumed low "cultural loading". However, the SPM is a test of analytical thinking and as such it is markedly affected by the extent and quality of schooling. Indeed, the Raven tests have shown strong secular gains in Western countries during the 20th century (Flynn, 1987). This shows that they are suitable as indicators for the cognitive manifestations of "modernization". In modernizing populations, thinking with abstract concepts is typically associated with exposure to formal education (e.g., Luria, 1976). Although the causes of the secular gains are not known with certainty, the Raven tests can therefore be considered as indicators for the extent to which abstract reasoning has been developed through the educational system.

The test was administered in 2016 to a representative sample of school students (1641 males, 1441 females) aged 6 through 18 years in the Cambodian capital city Phnom Penh and its suburban periphery. The sample was drawn from public elementary, middle and high schools and was representative of all sections

of the population for income, economic and social categories and of Muslims, Buddhists and Christians. In addition to SPM+ scores, information was available about age, school grade, and numbers of brothers and sisters. Also a crude measure of family income was available on a scale of 1 – 4, with 2690 out of 3062 subjects assigned to income level 2.

Results

The results are given in Table 1 showing for males and females the age, numbers, mean scores and standard deviations, and the IQs of the sex-combined samples according to the British norms published in Raven (2008).

Table 1. *Means ± standard deviations of the SPM Plus for males and females in Cambodia. Also shown are IQs calculated from the sex-averaged raw scores according to British 2007 norms.*

Age	Sex	N	Mean ± SD	IQ
6	M	122	19.0 ± 5.5	
	F	129	18.4 ± 5.4	
7	M	129	21.7 ± 5.6	96
	F	135	20.1 ± 5.8	
8	M	126	25.2 ± 7.0	98
	F	120	26.0 ± 7.4	
9	M	170	28.9 ± 5.9	93
	F	166	26.7 ± 6.3	
10	M	69	32.6 ± 6.1	95
	F	54	28.5 ± 9.0	
11	M	44	34.1 ± 6.8	97
	F	72	28.8 ± 10.8	
12	M	114	28.0 ± 12.2	101
	F	72	38.8 ± 7.5	
13	M	155	36.6 ± 4.1	100
	F	150	32.7 ± 7.2	
14	M	150	33.1 ± 8.3	100
	F	132	35.6 ± 5.7	
15	M	162	36.6 ± 5.5	104
	F	118	37.4 ± 4.3	
16	M	168	37.4 ± 5.0	107
	F	147	38.8 ± 4.1	
17	M	154	38.8 ± 3.6	102
	F	118	38.0 ± 5.6	
18	M	78	38.8 ± 3.7	107
	F	28	41.0 ± 3.8	

Relationships of SPM+ scores with other variables are shown in Table 2. We see that Raven scores are strongly related with both age and school grade. Correlations with family income are very weak, but there are more substantial relationships with sibship composition. Specifically, we see that a larger number of brothers is associated with lower scores while a larger number of sisters is associated with higher scores for both males and females. These observations with zero-order correlations in Table 2 are corroborated by the OLS regression models in Table 3. The adjusted R^2 values indicate that models that include school grade as a predictor are slightly more predictive than similar models that contain chronological age instead. This suggests that in Cambodia, schooling is at least as important as chronological age for the development of abstract non-verbal reasoning ability. However, the two variables are so highly correlated (r = .962, Table 2) that strong conclusions on this are not possible. The unimportance of family income is shown clearly in the regression models as well as in the correlations, and also the differential effects of brothers and sisters are confirmed.

Table 2. *Correlations (Pearson's r) of Raven raw scores with explanatory variables. Sample sizes are between 1434 and 1631 for correlations of male and female scores, and between 3059 and 3072 for the other (sex-combined) correlations.* * *p<.05;* *** *p<.001.*

	♂ score	♀ score	Age	Grade	Income	# Brothers
Age	.661***	.711***				
Grade	.688***	.743***	.962***			
Income	.059*	.030	.085***	.091***		
# Brothers	-.133***	-.161***	.005	-.019	-.181***	
# Sisters	.141***	.066*	.067***	.079***	-.164***	.010

Table 3. *Regression models predicting Raven raw scores. Standardized β coefficients are shown. * p<.05; ** p<.01; *** p<.001, two-tailed t tests.*

	Males		Females		Both sexes	
Males					.003	-.001
Age	.659***		.707***		.683***	
Grade		.683***		.737***		.710***
Income level	-.027	-.038*	-.030	-.030	-.030*	-.037**
# brothers	-.155***	-.140***	-.150***	-.137***	-.154***	-.140***
# sisters	.079***	.060**	.035	.036*	.056***	.045***
N	1628	1621	1432	1429	3060	3050
Adj. R^2	.463	.493	.526	.569	.493	.529

Discussion

The main result of this study are the rather high scores of the children, which correspond to IQs of about 100. This is on a par with scores in neighboring Vietnam, as well as in Europe and North America. When compared with the results of the two earlier studies using cognitive tests in Cambodia, this suggests substantial gains over a time period of about 25 years. However, there are some caveats about this conclusion. The only early study in the country, the one by Fergusson, Bonshek and Le Masson (1995), was done with small samples of students from institutions of higher education who were not representative of the general population. It is not certain whether and to what extent the cognitive level of these students was above the Cambodian average. The present study was done in the public school system rather than with university students, but it was limited to the capital city of Phnom Penh and its suburbs. Again there is no certainty whether these children are representative of school students throughout the country. Also the tests used in the three studies were different. Although all were tests of non-verbal abilities, they are otherwise quite different and can be compared only indirectly, through population-based norms established in Western countries.

Another important observation is that relative to the British children on whom the SPM+ test has been normed, test scores tend to rise with increasing age. This is opposite to what is frequently observed in other developing countries where cognitive test scores, relative to the British standard, tend to decline with

increasing age (Bakhiet et al., 2018). Age-related declines during school age are usually interpreted as indications of poor quality of schooling, or of other adverse conditions that impair children's intellectual development at that age. Conversely, the rising scores of school children in our Cambodian sample indicate a high quality of schooling, or possibly the presence of other environmental influences that are favorable for intellectual development.

Although little background information has been collected from the subjects in the study, the correlations of the test scores with the variables that we do have are interesting. While the dependency of scores on age and school grade is as expected, the non-predictiveness of family income would be considered unusual in modern Western societies. However, similar observations have been made in other developing countries. In one recent study, for example, the relationship between family socio-economic background and intellectual giftedness was found to be very weak in Sudan (Batterjee, 2017). The main reason for this appears to be that in most developing countries there has traditionally been little educational sorting into socio-economic status groups, and therefore not much of an "IQ meritocracy" that perpetuates itself across generations. Another possible reason is less assortative mating for education and intelligence in less gender-egalitarian societies. In these countries, intellectual talent is therefore spread rather evenly over all social classes rather than being concentrated in the upper classes as is the case in mature Western societies. In the case of Cambodia, however, conclusions have to be tempered by the very crude nature of the income measure.

Another observation relates to the number of siblings. The relationship between cognitive test scores and size of the family of origin is generally negative in modern Western societies, either because of fertility differentials favoring less bright parents, or because a larger number of siblings "dilutes" parental resources and thereby impairs mental development of the children (e.g., Rodgers et al., 2000). In the present study, the correlation between test score and number of siblings (with age controlled) is -.099. This correlation is negative, but not as negative as has commonly been observed in Western countries. Most surprising is that the presence of sisters is associated with higher test scores while the presence of brothers is associated with lower scores. The mechanisms and indeed the reproducibility of this result in Cambodia need to be further investigated, and data sets from other countries should be examined for the possible presence of this effect.

Finally, the gender differences are erratic with males obtaining significantly higher scores than females at some ages and females scoring higher than males at other ages. No clear age-related pattern of sex differences can be recognized.

This is different from a pattern of performance on the Raven tests that has been described in primarily Western countries, in which there is no gender difference up to the age of 15 years, but males slightly outperform females from the age of about 16 years (Lynn & Irwing, 2004). The large variability of sex differences at specific ages in the present study can be attributed to the fact that males and females in an age group were in many cases tested in different schools or different classes within schools.

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