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ADAPTATION OF COLUMBIA MENTAL MATURITY SCALE IN PAKISTAN

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This article describes the process of adaptation of the Columbia Mental Maturity Scale (CMMS). It reports the psychometric evaluation of the scale undertaken by means of item-analysis, and determination of cut-points for various levels within the scale for subjects of various age brackets and grades. This study aims at exploring the validity of the test for school children in Pakistan. The subjects consisted of 270 children of nursery through grade five, aged 3 to 10 years in urban school. Appropriate levels of the scale were administered individually to the subjects. The protocols of the subjects were scored and tabulated on a percentile scale. The scores increase systematically with increase in age and grade level. The reliability and the validity indices as obtained in this study characterize the Pakistani adapted version of the Columbia Mental Maturity Scale (CMMS-P) as a useful tool for children in Pakistan, specially in the school setting.

An emerging psycho-educational interest in Pakistan has emphasized the need for having valid and reliable instruments to assess cognitive capacity of the children. Some of the intelligence tests used in Pakistan include Raven's Progressive Matrices (Ansari & Iftikhar, 1984; Aziz & Farooqi, 1991), Wechsler Intelligence Scale for Children (Naheed, 1993), and Cattell's Culture Fair Intelligence Test (CFIT: Ain, 1985). Given the cultural, contextual and linguistic dissimilarities in the West and Pakistan, the tests developed in the West have certain limitations for use in Pakistan unless these are suitably adapted (for review see Mahmood, 1991). Although Raven's Matrices is a non-verbal test, and WISC has several non-verbal subtests, instruments using more commonly experienced non-verbal materials i.e., pictures of objects and animals especially for the children with the age range of 3

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to 10 years, are needed. It was, therefore, decided that the Columbia Mental Maturity Scale (CMMS: Burgemeister, Blum, & Lorge, 1972) may well be adapted in Pakistan, rather than constructing altogether another/new test of similar shape and design. This article describes the adaptation of CMMS in Pakistan, abbreviated as CMMS-P, beside assessing its current status as a research instrument and identify areas of further research.

CMMS-P is a general reasoning ability test for 3 years 6 months through 10 years old children in Pakistan. As a non-verbal test it can be applied to pre-school children through the elementary school grades. In the United States, the CMMS has been shown to be particularly useful in schools for decisions about selection and placement, and also for use with students who are language handicapped. When CMMS results are considered together with other pertinent information (e.g., school examination marks) about the child, the likelihood of understanding of his current capabilities is enhanced (Burgemeister et al., 1972). Culturally disadvantaged children may not feel uneasy with the CMMS-P as its contents refer to every day observations and life experiences, however, where this assumption is not tenable, this must be duly taken into account while applying this test or interpreting performance thereon. The clinical uses of the test with the mentally retarded or speech impaired children can also be explored as the test does not involve verbal responses and a minimal motor response is needed from the child.

CMMS-P consists of 92 pictorial and figural classification items. Each item is displayed on a 3 x 15 inch sheet in a booklet. There are generally four and rarely five options in an item. The child is to find out the picture/figure which is different from all others in an item. In order to find out the "different" picture, the child must formulate a rule for organizing various pictures in an item so as to exclude just one. The basis of discrimination ranges from perception of rather gross differences in size or form to recognition of very subtle relationship in pairs of pictures. The 92 items are arranged in a series of seven overlapping levels: two levels for preschool children, and five levels for grades 1 through 5. These levels are progressive and are arranged in approximate order of difficulty.

The administration and scoring of CMMS-P require no highly specialized training. With some practice under the supervision of the counsellor, a teacher can easily master the mechanics of test administration. The teacher or the tester has to make sure that he/she has correctly worked out the chronological age of the child from his/her

date of birth and is using the level that corresponds to the age of the child.

Adaptation Procedure

The contents of the test were critically reviewed in a series of sessions by a team of psychologists (with a minimum qualification of master in Psychology) to build a consensus as to how well the contents of the test fall within the observation and experience of Pakistani children. There were a total of 32 pictorial items which were partially modified to attune them to the Pakistani environment. For instance, a hat was changed to a *cap*, newspaper to *book*, skates to *shoes*, mitten to *sweeter*, fork to *spoon*, etc. The other items were retained in their original shape, except that 25 items presented in colour were converted into black and white, since a simple and economical monochrome booklet was intended to be produced in Pakistan. The researchers were conscious of the fact that colourful pictures have a special appeal to the children but economical printing of the test was an overriding consideration. The items in which colour alone served the basis of classification among a set of pictures were slightly reshaped by inserting some lines, e.g., diagonal or vertical stripes within to provide the basis of classification. However, the philosophy underlying the items and the rationale implied remained the same as in the original test. These modifications were subsequently tested on children of suitable age and grade in both urban and rural areas to ascertain children acquaintance and familiarity with the substitute contents. The subjects were thereafter put to clinical interview to verify the logic of classification or differentiation they applied to the modified contents. Some of the items were partially redrawn in pursuance of the above investigation (Aziz, 1993).

This exercise proved useful not only in giving a tentatively final shape to the test as a research tool in Pakistan but also served the empirical basis to lay down the order of the items in the scale. The overall order of the presentation of items in the adapted scale was in approximate order of difficulty within a conceptual framework of the cognitive ordering of the contents and mental strategies they involved to solve them.

In the light of subsequent exploratory work with the children, CMMS-P levels were set appropriate to chronological age and grade for the urban school children in Pakistan as shown in Table 1.

Table 1

Grade, age, and CMMS-P levels

Grades	Age Year & Month	CMMS-P Levels	Items
Pre-school Children			
Nursery I	3.4 - 4.3	A	1-50 (50)
Nursery-II	4.4 - 5.3	B	6-60 (55)
School Children			
Grade 1	6.4 - 6.9	C	11-65 (55)
Grade 2	7.4 - 7.9	D	16-70 (55)
Grade 3	8.4 - 8.9	E	21-75 (55)
Grade 4	9.4 - 9.9	F	26-85 (60)
Grade 5	10.4 - 10.9	G	34-92 (58)

Note: *Figures in parenthesis refer to the number of items in that level.*

Reliability

The CMMS-P preliminary report (Aziz, 1993) records *KR-20* index (Kuder & Richardson, 1937) in terms of internal consistency of the scale as .738 to .837 for various scale levels which indicates a satisfactory value for an ability test.

Item Analysis

Detailed analysis of first try-out of the test on children is separately documented (see Aziz, 1993). An abridged account of the analysis is reproduced here, to highlight the psychometric equivalence of the adapted version with the original one in sets of every 10 successive items. Table 2 indicates the number of children marking correct answer in each of nine different age groups of subjects.

Table 2

Frequency of correct response to clusters of 10 items each on original and adapted version

Item Clusters	Age Group								
	Lowest.....								.....Highest
1-10	**20**	**19**	**20**	**20**	**20**	**20**	**20**	**20**	**20**
	20	19	20	20	20	20	20	20	20
11-20	**15**	**18**	**18**	**19**	**18**	**19**	**20**	**20**	**20**
	16	19	18	19	20	20	20	20	20
21-30	**10**	**16**	**15**	**18**	**15**	**18**	**18**	**19**	**20**
	9	15	15	17	14	17	18	18	19
31-40	**6**	**7**	**10**	**11**	**10**	**12**	**13**	**14**	**15**
	7	10	10	12	11	15	16	16	19
41-50	**6**	**8**	**7**	**8**	**8**	**11**	**11**	**12**	**13**
	8	9	9	10	10	12	12	13	15
51-60	**7**	**8**	**9**	**10**	**8**	**11**	**12**	**11**	**15**
	4	5	9	8	8	10	9	12	13
61-70	**5**	**4**	**6**	**6**	**6**	**8**	**7**	**9**	**12**
	4	5	6	7	6	7	8	8	11
71-80	**4**	**4**	**5**	**5**	**5**	**5**	**5**	**6**	**8**
	3	4	5	5	5	5	5	6	8
81-90	**3**	**5**	**5**	**5**	**5**	**4**	**6**	**6**	**7**
	3	3	3	3	3	3	4	4	5
91-92	**0**	**1**	**1**	**3**	**3**	**1**	**2**	**2**	**5**
	0	1	1	4	2	2	2	2	5

Note: *Unbold figures refer to scores obtained on original test (CMMS). Bold figures refer to the same on the adapted version (CMMS-P).*

N = 180 subjects comprising 20 pupils each in different age groups.

It is pertinent to note that scores for each item cluster increased from low to high age groups. Also the frequency of correct response as a facility index of the item-clusters decreased with the successive difficult items. This established the goodness of item-arrangement in the adapted version and ratified the harmony of the conceptual lay out of the modified contents in the adapted/Pakistani version.

The present study aims at extending research work done on Columbia Mental Maturity Scale in Pakistan. An attempt is made herein to explore the validity of the test for Pakistani school children. The assumption is that mental maturity increases with age as one gains more life experiences. The test would be thus considered valid if the scores obtained by children of various age brackets are differentiated.

School provides a host of experiences which enhance the cognitive ability and skills of the pupils. The story books, basic facts of science, principles of mathematics, drawing, and other school activities cultivate in children an ability to reason, analyze and differentiate among objects and symbols. Findings from cross cultural research have demonstrated that an important mechanism through which schooling influences intellectual maturity is by promoting a disembedded manner of cognizing that is not yoked to direct personal experience (Irwin, Engle, Yarbrough, Klein, & Townsend, 1978; Rogoff, 1981). Aziz and Farooqi (1994) reported that schooling appears to facilitate several perceptual and conceptual skills required for the successful performance on IQ tests. The schooling or school experiences would thus be a significant factor loading on the performance of children on CMMS.

In fact, the factors of age and grade as level of school experience are inter-twined. The research design, therefore, deemed appropriate for this study is 'age at grade' paradigm, however, this posses formidable problems in Pakistan as the age of the children is not controlled or tuned to the grade they study in, specially in the rural areas. Low literacy rate, poor standard of living, inadequate school facilities and poorly executed educational programmes explain some of the causes of this educational lag. Thus, grade does not imply homogeneous age-group in Pakistan and age overlap between grades is susceptible to confound results on cognitive measures. Ansari and Iftikhar (1984), and Pervez (1980) describe in detail the difficulties faced in drawing a 'age at grade' sample for their respective studies which required to commission nationally representative sample. They reported that age record was not properly kept, verified, or documented in the school. It was at best an estimated age as reported by the parents. The reported

age actually made out wide-ranging age cohorts for various grades with very uneven distribution. These problems were kept in view while drawing an 'age at grade' sample in this study.

METHOD

Sample

The stratified sample includes 270 children which is not a small sample considering the resource and time expended on individually administered devices specially with very young children. Subjects of pre-school age (3-5 years) were taken from a nursery in Rawalpindi city for convenient and economic access to subjects than a door to door hunt for them. Pre-school nurseries have recently emerged in urban areas, therefore, only urban subjects were taken. While extending the sample to 6-10 years old school children, a mixed boys and girls government primary school was selected for this purpose.

Table 3

Demographic features of the subjects

Grades	Modal Age	Subjects			CMMS-P Level Applied
		Boys	Girls	Total	
Pre-school Children					
Nursery I	3+Years	20	20	40	A
Nursery II	4+Years	30	30	60	B
School Children					
Grade 1	6+Years	15	19	34	C
Grade 2	7+Years	16	19	35	D
Grade 3	8+Years	15	16	31	E
Grade 4	9+Years	16	19	35	F
Grade 5	10+Years	17	18	35	G
				270	

The school record was consulted to ascertain age-pattern of the grades 1-5, which as expected, overlapped across grades. Since age is related to increase in mental maturity as reflected in CMMS-P scores, the stratified sample across grades had to be controlled for the factor of age to obtain meaningful and reliable research results. The 'block

technique' (Eva & Torry, 1981, p. 162) was applied to crystallize sample by age by estimating modal age of each grade in the school, which came to be 6+ for grade 1 through 10+ for grade 5. Leaving out the pupils who fell beyond the modal age brackets for a given grade, blocks of the children of homogeneous age were created. This purported to control age variation on the extremes that was otherwise likely to induce error in the CMMS-P scores across grades. This nearly met 'age at grade' concept normally implied in developmental scales as in CMMS. The sample pruned and smoothened in this manner had the details as shown in Table 3.

There was not enough information available in the school record to ascertain socio-economic status (*SES*) of the subjects, therefore, this feature was not specifically studied, however, it was assumed that based on probability theory, *SES* factor would be scattered, hence balanced across the subjects. Even otherwise also the sample as stratified into various grades did not allow a further pruning of subjects by *SES* factor, or the number of subjects would become smaller to warrant reliable statistics.

Procedure

The CMMS-P was administered individually to the subjects in their respective schools. Special care was taken to keep the distractions to minimum. Administration of the scale took 20-25 minutes on average per subject including the pre-test motivating talk and alleviating the test anxiety of the child. After demonstrating three sample items, the subjects were presented the appropriate scale levels corresponding to the age. They were instructed to "point out the picture that is not like the others". As the child responded to each item, the tester noted the answer on the answer sheet. Each item carried one score if answered correctly. Standard key was used for scoring the scale.

RESULTS AND DISCUSSION

Appropriate levels of the scale were administered to individual subjects by a team of three testers under the standard instructions. The data of boys and girls were collapsed to create a more sizable sample and reliable statistics, as sex differences have not been earlier found on CMMS-P scores among primary school children (Aziz, 1993). The

protocols of the subjects were scored and tabulated on a percentile scale (see Table 4).

Table 4

CMMS-P percentile ranks by grade and age in years

Percentile Ranks	Nurs-I 3+	Nurs-II 4+	1 6+	2 7+	3 8+	4 9+	5 Grade 10+Age
10	8.1	13.1	20.0	22.1	26.0	30.7	27.4
20	13.2	18.0	23.0	27.0	28.6	33.0	32.4
30	20.6	25.6	27.5	28.3	29.9	34.0	36.0
40	23.0	29.0	31.0	29.4	32.0	35.8	39.0
50	24.5	34.0	33.0	31.0	33.5	37.0	40.0
60	27.0	36.6	35.0	32.0	34.8	39.2	42.0
70	29.4	38.0	36.5	34.7	36.1	42.9	43.0
80	35.0	40.0	39.0	36.8	38.4	45.6	46.6
90	39.0	42.0	42.0	38.9	42.7	48.6	50.6
95	40.9	44.0	43.0	42.5	44.0	49.3	51.0
99	-	-	-	-	-	-	-

A systematic progression in the scores of nursery to grade 5 subjects is found along every 10th percentile. This monotonic progression lends support to the validity of the test, and it is also in agreement with the classical theory of Binet and Simon (1905) in their early work on the measurement of ability. In addition, scores on the test increased systematically with increase in age, a finding also in agreement with the validational theory of Binet and Simon. Further, there is an ample evidence to confirm the acuteness of the cut-point of the scale levels A-G on CMMS-P as determined earlier in a preliminary study (Aziz, 1993).

Levels A to G of CMMS-P as applied to children of 3+ through 10+ in this study revealed a generally systematic scoring pattern. Small ruffles here and there can be attributed, on the basis of probability theory, to individual differences in mental maturity among subjects within a grade since a grade is a unit of children of a certain range rather than fixed ability 'point'. Although boys and girls are almost

equally distributed in the stratified sample, CMMS-P scores are held to be free from sex bias. Tyler (1965) may well be quoted to emphasize the point of individual difference within grade; "differences between the sexes are generally so small and differences between individuals of the same sex are so large that it is possible to find an individual who, regardless of his/her sex, will show almost any specified degree of any special ability" (p. 247). An allowance for this factor has to be made while scrutinizing score-grid across grades. Another allowance is also due in this respect considering the fact that as an individually administered test, three testers were engaged to administer the test to the children of various grades. There is no denying the fact that probable chance error on account of inter-tester difference could also have affected the score-grid across different grades.

CONCLUSION

The psychometric evidence as revealed above indicates that the use of CMMS-P as an adapted test seems promising in Pakistan. This test can be further refined by undertaking future studies on a still larger sample so as to also yield a normative data for tentative use of the test as a research instrument. Two areas for future research work would be: (a) Relationship between CMMS-P score with other criteria than the 'grade' itself, for instance, marks obtained in the end of course examinations, and (b) relationship with *SES* index comprising educational level of the parents and their income. The CMMS-P scores combined with school attainment may prove to be more wholesome and better predictor of an individual child success in school than either one of these indices. A study on the rural children would also be interesting and informative. At the present stage, CMMS-P is worth the use as a research instrument and it bears scope for further development.

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