VERBAL INTELLIGENCE AS MEASURED BY THE NLTVI AND ITS RELATION WITH DIFFERENT SUBJECTS TAUGHT IN SCHOOL

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SUMMARY: This study aims at evaluating the differential predictive ability of the Non-Language Test of Verbal Intelligence The test was administered on 1305 students reading in Class VIII in 17 different schools at Calcutta. It was observed that the four parts of the NLTVI were almost equally correlated with the marks in different subjects taught at the Class VIII level. The multiple correlation of these parts with the language total and the non language total were almost of the same magnitude. Intercorrelations among different school subjects revealed high degree of relations. The factor analysis of this intercorrelation matrix revealed that from the point of similarity of factor loadings Geography and General Science were closer to English and Bengali than to a subject like Mathematics. It can also be concluded from the results that English, Bengali and Sanskrit (language subjects) were not measuring some common ability which could be identified as language ability. So it is not surprising that these scores on languages, and the non-language subjects scores were not differentially correlated with the NLTVI. But however, its relation with school achievement was not very much different from the one obtained earlier with a verbal intelligence test. Hence, it can be said that this test was of equal standing as that of a verbal intelligence test using language.

Introduction : An earlier study (1) describes the procedure followed in developing the non-language test of verbal intelligence (NLTVI) in detail along with some validity coefficients obtained from a small scale follow up study of the test with over-all academic achievement of the students as criterion. In that study no attempt was made to investigate the validity of the test with respect to different subjects taught in school. This study is taken up to evaluate the differential predictive ability of the test with respect to different subjects, if any.

In addition to this it was planned to get a linear composite score with the separately timed part scores of NLTVI which would have a maximum correlation with the total marks in three languages viz., English, Bengali and Sanskrit included in the school syllabus ; another composite score which would have maximum correlation with total marks in the non-language subjects like Mathematics, Geography, Science, was also decided to be computed. After computing these it could be tested whether the ability measured through the NLTVI correlated more with the language subjects than with the non-language subjects or not.

Description of the Test : Before proceeding further a brief description of the NLTVI is presented here. For detailed description the manual (2) of the test may be consulted. There are four parts in the test which are separately timed and the total time allowed for the entire test is 45 minutes. Each of these parts consists of one particular type of item and the following four types of items are included in these four parts viz., Analogy, Classification,

Opposites, Picture Arrangement. The items are presented in such a way that while mentally solving these items the candidate has to take the help of language. Language would serve only as the intervening variable between the visual presentation of the non-language material and final answering by the candidate. The basic difference between a non-verbal test and this new type of non-language test lies in the fact that many types of non-verbal items like those in progressive matrices etc., may be solved at the perceptual level but as defined earlier the latter type essentially involves the use of language as the intervening factor. It may be true that non-verbal tests as they in many cases do not involve the use of language fail to provide an accurate prediction of future academic performance which involves the use of language to a great extent when compared to the predictive ability of verbal tests used for the same purpose. Hence, it was reasonably expected that this type of non-language test would adequately meet the challenge arising from the multilingual nature of the country and the need for accurate prediction. The test is standardised on the basis of more than 1500 students reading in class VIII. The correlations of the NLTVI part scores with a verbal reasoning test in Bengali were computed and the obtained values are ·64, ·56, ·38 and ·45 respectively. All these values are significant at the 1% level. The validity coefficients as observed by correlating the total of the four part scores with the total of the annual (Class IX) school examination marks was as high as ·60 for the boy's science group (2).

The sample and collection of the data: As the test in question was suitable for the class VIII level, the sample for this study consisted of classVIII students from 10 boys' and 7 girls' Higher Secondary Bengali medium schools at Calcutta which were selected at random. There were 498 girls and 807 boys in this group. The test was administered at the middle of the year after the end of the Summer Vacation.

Analysis of the data: First of all the mean scores and the standard deviations of all the four parts were obtained separately for the boys and girls group as well as for the combined group. The values are presented in Table-1. The differences between the corresponding pairs of means

TABLE-1

Showing the means, standard deviations of the four parts of the NLTVI for the boys', girls' and the combined groups

NLTVI Parts	Max. Poss. Score	Boys N= 807 X	s.d.	Girls N= 498 X	s.d.	Total N= 1305 X	s.d.	t-value B X G
Part I (Analogy)	20	11·08	3·46	10·84	3·40	10·99	3·44	·39
Part II (Classification)	14	8·29	2·36	8·12	2·26	8·22	2·32	·41
Part III (Opposite)	14	7·80	4·22	8·14	3·24	7·93	3·88	·52
Part IV (Picture Arrangement)	14	7·03	3·76	6·50	2·89	6·83	3·46	·90

were tested for significance and the obtained t-values are also presented in the same table. All the t-values are however insignificant which proved that though the means were not identical yet the obtained differences between the two sex groups were not significant.

In order to investigate the nature of the part scores and the existing relations among them, the inter-correlations among parts were computed and the obtained product-moment values are presented in Table 2.

TABLE 2

Showing the intercorrelations among the four parts of the NLTVI for the combined group of boys and girls (N=1305)*

NLTVI Parts	Part I	Part II	Part III	Part IV
Part I	—	·42	·32	·30
Part II	·42	—	·35	·32
Part III	·32	·35	—	·56
Part IV	·30	·32	·56	—

*All the correlations are significant at the 1 Per cent level.

Except for two correlations i.e., between Part I and Part II and between Part III and Part IV, other four correlations were considerably low and this indicates that the parts were not measuring the same thing. This is desirable because otherwise there is no point in keeping separately timed parts within the test.

The nature of the Criterion used i.e., the school examination marks: The available measures of achievement in school subjects for those students upon whom the test was administered were class VIII annual examination marks and these marks were collected from different schools at the end of the year.

Scrutiny of the class VIII annual examination marks revealed that though some of the subjects taught by different schools were not identical, yet there were seven subjects which were common for all of them viz , English, Bengali, Mathematics History, Geography, General Science and Sanskrit. So only these seven subjects were considered in this study. It was also observed that the maximum possible marks were not identical in each of the selected schools. In order to do a combined group analysis, the marks in different subjects were so adjusted by using suitable multipliers that the maximum possible marks in any subject were same for all the schools. It may be mentioned here that there might be some differences in the question papers as well as in the method of evaluation in different school subjects, but as no common achievement score was available for all the students there was no other alternative but to use these adjusted school marks.

The means and the standard deviations of the marks in the seven subjects were separately obtained for the boys' and the girls' and also for the combined groups. The values are presented in Table 3. The difference between the corresponding pair of means were tested for significance and the obtained t-values are also presented in Table 3.

TABLE 3

Showing the means, standard deviations of the school subjects
for the boys and girls groups and also for the combined groups.

Subject	Max. Poss. Marks	Boys N= 807		Girls N =(498)		t– value	Total N= 1305	
		X	s.d.	X	s.d.		X	s.d.
Bengali	200	84·09	20·66	78·70	26·70	3·85**	82·03	23·29
English	200	71·99	24·96	63·48	28·78	4·17**	69·51	26·66
Mathematics	100	39·35	22·23	34·53	26·27	3·42**	37·51	23·96
Sanskrit	100	38·72	18·74	43·76	19·39	4·62**	40·64	19·14
History	100	40·37	12·61	42·55	37·93	0·75	41·20	25·45
Geography	100	42·23	15·91	39·69	15·46	2·88**	41·26	15·78
G. Science	100	47·65	16·11	38·98	16·18	9·42**	44·34	16·67

**Indicates significant at the 1 per cent level.

Comparing the results of the boys' and the girls' groups as presented in Table-3, it can be said that the average performance of the boys was significantly better than that of the girls, in five out of seven subjects, and in two subjects only, viz., Sanskrit and History, the girls were better than the boys and in case of Sanskrit only this was significant. Such a trend was observed with the NLTVI part scores also. As most of the averages are round about 40, the conclusion that can be drawn from it is that the examinations in question were a bit difficult for the groups concerned.

As mentioned earlier the purpose of this study was to investigate the nature of the relations existing between verbal intelligence and achievement in school subjects. Moreover, it was thought that it would be also interesting to study the difference between the relation of verbal intelligence with the language subjects and that with the non-language subjects. This can be compared by computing the multiple correlation of the NLTVI part scores with the total score in languages and comparing it with that obtained with the total marks of the non-language subjects as the criterion.

Relation between NLTVI scores and School examination marks : The relations among the NLTVI part scores and the marks obtained in different school subjects were investigated by (a) Computing the zero order correlations among the school subjects and NLTVI parts and then (b) Computing the multiple correlations of the NLTVI part scores with (i) the total marks in languages as criterion and (ii) the total marks in non-language subjects as criterion.

(a) *Computation of zero order correlations between NLTVI and school marks:* These zero order correlations were calculated separately for the boys, girls and also for the combined groups. The obtained values are presented in Table 4. Examination of the figures presented in Table-4 shows that almost all of them were significant at the 1% level. The lowest obtained correlation was between Part-1 of the NLTVI and the school examination marks in General Science ($+·02$) for the boys' group and the highest obtained correlation was $+·37$ between Part-III and the school examination marks in English for the girls' group. It may be noted here that the correlation coefficients obtained with language subjects

TABLE 4

Showing the correlations among four different part scores of NLTVI
and different subject scores for boys, girls and the total groups

NLTVI Parts	Groups	Beng.	English	Math.	Sans.	Hist.	Geog.	G. Sci.
I	Boys	·29	·26	·27	·27	·29	·26	·12
	Girls	·24	·22	·22	·15	·07§	·18	·29
	Combined	·27	·25	·25	·22	·13	·23	·19
II	Boys	·25	·24	·24	·23	·16	·18	·15
	Girls	·20	·28	·23	·17	·11*	·19	·31
	Combined	·23	·25	·24	·20	·11	·19	·21
III	Boys	·22	·20	·20	·21	·19	·17	·11*
	Girls	·28	·37	·25	·23	·15	·27	·31
	Combined	·23	·25	·21	·22	·14	·20	·15
IV	Boys	·16	·09*	·07§	·11*	·16	·15	·02§
	Girls	·17	·26	·21	·14	·14	·21	·26
	Combined	·16	·16	·13	·11	·12	·17	·11

*indicates significant at the 5 per cent level

Note : All figures excepting those marked * and § indicate significant at the 1 per cent level.

were not very much different from those obtained with non-language subjects.

(b) Multiple Correlation : In order to see whether prediction with the NLTVI scores could be maximised by using different weights for the four parts, regression analysis was done with school examination marks as criterion. This was done separately for the language total, non-language total and the grand total marks for the boys', girls' and the combined groups. Language total consisted of the total marks in the language subjects viz., English, Bengali and Sanskrit ; non-language total was the sum total of the marks in subjects like Mathematics, General Science and Geography. Marks for History, was excluded from both the groups as its classification in any one of the two groups was thought to be unjustified, and hence it was included only in the grand total.

The obtained regression coeffici-ents and the multiple correlation coefficients are presented in Table 5. At the time of calculating the multiple correlation the scores were taken without the decimal points and this accounts for the low magnitude of the obtained regression weights. It may be noted that this calculation was done by using the 1401 EDPM system.

It can be seen from table 5 that the obtained multiple correlations were all significant at the 1% level and the degree of the relationship was fairly high to be obtained with the part scores of a single test. The multiple correlations obtained against the language total were however not very different from those obtained with the non-language total or even from those obtained against the grand total of all the subjects. Even in the girls' group the multiple correlation obtained with the non-language total as criterion was higher than that obtained with language total as the

TABLE 5

Showing the regression coefficients, multiple R, number of cases for different groups with language total, non-language total and grand total as the criteria

Reg. Wts.		Criterion								
		Language Score			Non-language score			Grand Total Score		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
b_1	·0370	·0155	·0307	·0261	·0200	·0249	·0722	·0342	·0614
b_2	·0343	·0254	·0361	·0250	·0245	·0290	·0603	·0546	·0690
b_3	·0240	·0492	·0273	·0175	·0264	·0155	·0447	·0881	·0479
b_4	−·0124	·0129	−·0050	−·0124	·0134	·0026	−·0244	·0373	·0048
a	115·3605	102·1735	110·5346	74·6789	41·9807	61·5772	216·7484	166·7840	197·8203
Multiple R	·38**	·37**	·36**	·33**	·38**	·34**	·38**	·38**	·36**
No. of cases	807	498	1305	807	498	1305	807	498	1305
Max. Correlation (Zero order) and the Corresponding Part	·32**	·34**	·28**	·27**	·31**	·28**	·32**	·34**	·29**
	(P-I)	(P-III)	(P-I)	(P-I)	(P-III)	(P-I)	(P-I)	(P-III)	(P-I)

** Indicates significance at the 1 per cent level

criterion. This indicated that the separate grouping of the school subjects into language and non-language was perhaps not justified and there might be considerable amount of overlapping among the subjects in terms of the factors involved. It was felt worthwhile to do a factor analysis of the school examination marks for obtaining additional information as to their nature.

It was further observed that Part III of NLTVI had the highest obtained validity coefficient for the girls' group and Part-I had the highest correlation for the boys' group, with respect to the language total, the non-language total as well as the grand total as the criterion. It may be worth mentioning here that the increase in the validity coefficients by adding other parts with the maximum predicting part (i.e., Part-I in case of the boys' group and Part III in case of the girls' group) was not considerably high in all the groups though the increase in the value of multiple R by adding other parts to the most predicting part was statistically significant

(See Appendix A). Further test was made to ascertain whether the two sets of regression coefficients corresponding to the two groups (boys' and girls') were significantly different or not. The F values obtained by following the statistical procedure suggested by Rao (4), were 4.12, 9·54 and 5·42 with 5 and 1295 degrees of freedom, with language total, with non-language total and grand total as criterion respectively and these indicated significant differences at all points and hence it was concluded that the two groups should not be combined to get a common set of regression weights (See Appendix B).

Further Analysis investigating the nature of the Criterion Used : To start with the intercorrelations among the school subject marks were calculated after pooling the entire data as the purpose was just to ascertain whether a distinct grouping of the school subjects into language and non-language could be made or not. The obtained product-moment values are presented in table-6.

TABLE 6

Showing the intercorrelations among the school subjects
for the total group (N = 1305)*

Subjects	Bengali	English	Maths.	Sanskrit	History	Geog.	Gen. Sc.
Bengali	—	·67	·49	·59	·34	·56	·50
English	·67	—	·52	·60	·27	·52	·51
Math.	·49	·52	—	·51	·58	·45	·47
Sanskrit	·59	·60	·51	—	·39	·53	·32
History	·34	·27	·58	·39	—	·23	·22
Geography	·56	·52	·45	·53	·23	—	·46
Gen. Sci.	·50	·51	·47	·32	·22	·46	—

*All the correlations are significant at 1 per cent level.

Examination of the figures presented in Table 6 shows that the language scores were also considerably related with the non–language subjects like Mathematics, Geography and General Science besides being related with other language subjects For example, the score in Bengali was highly related with the scores in Mathematics, Geography, and General Science—correlations being ·49, ·56 and ·50 respectively, though the highest correlation for this variable was with English (·67). Similar trend was also observed for the other two language subjects viz., English and Sanskrit. Moreover for the non–language subjects like Geography and General Science the highest two correlations were with Bengali and English. It is surprising that these two subjects were more related to languages than the other subject like Mathematics, with which they were classified earlier.

From the above discussion it follows that it was not unnatural that the relation between the NLTVI and the language subjects and that between the NLTVI and the non–language subjects were not much different. In order to get further information in this respect factor analysis of the school examination marks was done.

Four centroid factors were extracted by utilising the inter-correlation matrix presented in table 6. The significance of the extracted factors was tested by means of Humphrey's rules (5) and the test indicated that the first three factors were significant while the fourth one was insignificant.

In order to get meaningful factors the reference axes was rotated orthogonally and the rotated factor loadings are presented in table-7.

TABLE 7

Showing the rotated centroid factor loadings of the school subjects

Subjects	I	II	III	Communality
Bengali	·803	·017	·151	·688
English	·801	·002	·129	·658
Math.	·567	·556	·237	·687
Sanskrit	·641	·000	·498	·659
History	·310	·565	·352	·539
Geography	·706	·011	·098	·508
Gen. Sci.	·666	–·022	·026	·445

From the factor loadings presented in table 7 it can be observed that the two languages, Bengali and English, had almost equal factor loadings in the three factors, while Sanskrit, unlike the other two languages, had high loadings in factor III. From the point of similarity of factor loadings. Geography and General Science were closer to English and Bengali than to subject like Mathematics. Hence it can be concluded that English, Bengali and Sanskrit were not measuring some common ability which in previous multiple regression analysis was identified as measuring the language ability. Similarly Mathematics, Geography and General Science which were grouped as non–language subjects did not possess similar factor load-

ings with respect to the three centroid factors extracted. So it is not surprising that these language scores and non-language subject-scores were not differentially correlated with the verbal intelligence as measured by the NLTVI. The grouping of the language and the non-language subjects as done earlier was not based on the fact that the between group subjects were measuring different factors and within group subjects were measuring the same factors. Actually what the school subjects are measuring or how many independent groups can be formed with them is a problem for different investigation and should be carefully examined by factorially analysing the correlation matrices among the subjects.

From the factor loadings it is observed that these examinations in languages are not all measuring something which can be identified as the ability to master language and is something independent of what is covered by the examination in other subjects like Mathematics, Geography, and General Science. It may be true that except Mathematics, the other two subjects Geography and General Science require the help of language ability as the ability of expression though language adds something towards the success in these examinations

and hence factor loadings of these two subjects are more or less similar to those of English and Bengali. But it is difficult to establish the truth underlying this assumption at the present stage of this investigation.

It may be mentioned here that in a study with a standardized verbal reasoning test (3) administered on a similar group of students (i.e., Class VIII students), it was however observed that the correlation of this verbal reasoning test with Class IX Grand Total marks for five different subgroups (subgrouped on the basis of sex and stream of study) with 59, 1955, 104, 202 and 111 students were ·65, ·31, ·27, ·24, and ·22 respectively. Though all the values were significant yet the coefficients were not much different from (except in one case) those obtained with the linear composite score of the parts of the NLTVI. Hence, it can be said that from the point of prediction of academic achievement this non-language test is equally qualified with a verbal intelligence test which uses languages as the medium. But it is desirable to conduct a cross validation study by administering NLTVI and some standardized verbal intelligence test on the same group of students. Such a study is in progress and would be duly reported.

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Appendix-A

Showing the analysis of variance for testing the significance of the increase in the multiple R by using other parts of the NLTVI with the marks of all subjects as criterion.

A-Total Group:

Source of variation	d. f.	Sum of squares	Mean square	F
Regression	4	2249491	562373	50.00**
(i) one variable	1	1452720	1452720	129.21**
(ii) Remainder	2	796771	265590	23.62**
Residual	1300	14616509	11243	
Total	1304	16866000		

B-Boys' Group:

Source of variation	d. f.	Sum of squares	Mean square	F
Regression	4	1264665	316166	34.70**
(i) one variable	1	899873	899873	98.70**
(ii) Remainder	3	364792	121585	13.35**
Residual	802	7306635	911	
Total	806	8571300		

C-Girls' Group:

Source of variation	d. f.	Sum of squares	Mean square	F
Regression	4	119021	299755	21.2**
(i) one variable	1	964246	064246	68.19**
(ii) Remainder	3	234775	78251	5.53**
Residual	493	6970389	14139	
Total	497			

** significant at the 1 per cent level

Showing the analysis of variance for testing the significance of the increment in the multiple R by using the other parts of the NLTVI with the most predicting part with language subjects as the criterion.

A-Total Group

Source of variations	d. f.	Sum of squares	Mean squares	F
Regression	4	606463	151616	48.41**
(i) one variable	1	376913	376913	120.35**
(ii) Remainder	3	229550	76509	24.42**
Residual	1300	4071367	313182	
Total	1304	4677830		

B-Boys' Group

Source of variations	d. f.	Sum of squares	Mean squares	F
Regression	4	361578	90395	34.29**
(i) one variable	1	249616	249616	94.69**
(ii) Remainder	3	111962	37317	14.15**
Residual	802	2114022	2636	
Total	806	2475600		

C-Girls' Group

Source of variations	d. f.	Sum of squares	Mean squares	F
Regression	4	294906	73727	19.20**
(i) one variable	1	251713	251713	65.55**
(ii) Remainder	3	43193	14396	3.74*
Residual	493	1892874	3840	
Total	497	2187780		

Showing analysis of variance for testing the significance of the increase in the multiple R by using the other parts of the NLTVI with the most predicting part with the marks in the non-language subjects as criterion.

A-Total Group

Source of variations	d. f.	Sum of squares	Mean squares	F
Regression	4	327823	81956	42.31**
(i) one variable	1	223171	223171	115.21**
(ii) Remainder	3	104652	34884	18.01**
Residual	1300	2517707	1937	
Total	1304	2845530		

**indicate significant at the 1 per cent level
*indicate significant at the 5 per cent level

B–Boys' Group

Source of variations	d. f.	Sum of squares	Mean squares	F
Regression	4	175978	43994	25.10**
(i) one variable	1	118963	118963	67.87**
(ii) Remainder	3	57015	19005	10.85**
Residual	802	1405622	1753	
Total	806			

C–Girls' Group

Source of variations	d. f.	Sum of squares	Mean squares	F
Regression	4	176006	44001	21.40**
(i) one variable	1	123885	123885	60.22**
(ii) Remainder	3	52121	17374	8.45**
Residual	493	1014134	2057	
Total	497	1190140		

Appendix-B

Showing analysis of variance for testing the equality of regression coefficients obtained with the boys and the girls group with.

(A) the grand total as the criterion

Residual due to	d. f.	Sum of squares	Mean squares	F
Deviation from Hypothesis	5	299867	59973	5.42**
Separate Regression	1295	14316643	11055	
Common Regression	1300	14616509		

(B) the language total as the criterion

Residual due to	d. f.	Sum of squares	Mean squares	F
Deviation from Hypothesis	5	64471	12894	4.12**
Separate Regression	1295	4006896	3127	
Common Regression	1300	4071367		

** indicates significant at the 1 per cent level

(C) the non-language subject total as the criterion

Residual due to	d. f.	Sum of squares	Mean squares	F
Deviation from Hypothesis	5	97951	19590	9.54**
Separate Regression	1295	2419756	1869	
Common Regression	1300	2517707		

** indicates significant at the 1 per cent level