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This study was designed to factor analyze the correlation matrices of a number of studies utilizing the Illinois Test of Psycholinguistic Abilities (ITPA). All of the correlation matrices were analyzed on the same program using the same criteria. By this approach, it was possible to examine trends between studies. More factors tended to appear as chronological age increased. Although there was little consistency of factor structure between age groups, analyses of three groups at the same age level produced a reasonable amount of consistency. Analyses of the three major dimensions of the ITPA (channel, level, and process) revealed that channel differentiation was best achieved by the test. There was little in the way of differentiation in the younger age groups for the level and process evaluation. However, for the older age groups (approximately six years and above), it appears that the test was moderately successful in assessing some of the dimensions for which it was intended. (Author/DO)

A COMPARISON OF THE FACTOR STRUCTURE OF THE ITPA ON 18 FACTOR ANALYSES[1]

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Analyses of the three major dimensions of the ITPA, i.e., channel, level, and process revealed that channel differentiation was best achieved by the test. There was little in the way of differentiation in the younger age groups for the level and process evaluation. However, for the older age groups, i.e., approximately 6-0 and above, it appears that the test was moderately successful in assessing some of the dimensions for which it was intended.

The Illinois Test of Psycholinguistic Abilities (ITPA) was designed as a diagnostic test to assess 9 separate linguistic functions of children between the ages of 2.5 and 9 years. The test is based on a communication model developed by Osgood (1957a; 1957b). The total battery is made up of 9 subtests which are designed to assess separate "single abilities." On the basis of the test results, strengths and weaknesses in the child's language development are assessed with the goal of the diagnosis being a highly specific remediation program.

One of the major assumptions underlying the use of the ITPA in this fashion is that the test actually assesses "single abilities" which are mutually exclusive. Factor analysis provides one method for testing the accuracy of this assumption. Two studies reported thus far have attempted to support the "single abilities" assumption (McCarthy & Kirk, 1963; Semmel &

Mueller, 1963). Both studies involved methodological questions which required a re-evaluation of findings (Ryckman, 1966). Several other studies have also applied factor analytic methods in examining the ITPA (Center, 1963; Loeffler, 1963; Mueller, 1965; Ryckman, 1966). However, it is difficult to evaluate the similarities and differences reported in these studies since the researchers used different analytic methods and techniques.

As a result of the methodological questions and different analytic methods, it was considered desirable to refactor the correlation matrices using the same factor analytic program. A search for trends, which could have importance in clinical and research use of the ITPA, was made possible. The results are presented here.

Primary emphasis has been centered on the analysis of the original correlation matrices for the standardization population (McCarthy & Kirk, 1963). In addition, correlation matrices from studies by Center (1963), McCarthy and Olson (1963), Mueller (1965), and Semmel and Mueller (1963) were analyzed. Center's study involved 23 boys and 25 girls between the ages of 8 and 9 years (approximate mean CA = 8.5 years; Mean IQ-104.9; s.d. 7.6). McCarthy and Olson's study involved 86 children with a CA range of 7-4 years to 9-2 years (Mean CA = 8-3 years; Mean IQ-105.4; s.d. 9.1). Mueller studied 101 young educable retardates (Mean CA = 9.1; Mean IQ-65; s.d. 7.6), and Semmel and Mueller studied 118 retarded subjects (Mean CA = 12-7; Mean IQ-49). These matrices were submitted to a Principle Axis Factor analysis. The factors which emerged with eigenvalues greater than 1 were then rotated to Varimax criterion. Unity was used as the communalities estimate in all matrices.

A summary of the results of the factor analyses is presented in Table 1.

Insert Table 1 about here

The number of factors with eigenvalues greater than 1 which emerged for the different groups varied from 2 to 5. The only analysis with a single factor was for the total standardization population. The factor is probably an artifact of chronological age, and increasing language ability with age. An interesting age trend is also revealed in the table. As the age of the standardization population increases the number of factors which appear also increases. While this is not a smooth progression, it is noticeable that there are fewer factors at the lower age levels than at the upper age levels. The groups of Mueller (1965) and Semmel and

Mueller (1963) did not fit this trend. Both studies were done with retardates, educable and trainable, respectively.

Table 2 presents a closer look at the factors and loadings of three representative age levels. At the 3-0 age level two language factors emerge. The

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Insert Table 2 about here

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first appears to be a general language ability factor with a strong auditory-vocal channel emphasis. With varying consistency the factor is noted at nearly all age levels. The visual motor channel is heavily represented on the second factor. At the 5-6 age level, the number of factors increases to three. The first factor at both the 5-6 and 3-0 age levels is similar. The second factor is somewhat confusing, but the third seems to represent a visual-motor factor. At the 8-0 level, there are four factors which do not resemble any of the other two age level factors. Factor 1 could be considered a general language factor, Factor 2 an encoding factor, Factor 3 a memory factor, and Factor 4 a visual decoding factor. It is apparent that there is more differentiation at this age level than at the others.

The factor analytic structures at these three age levels indicated that there are increasing numbers of factors as the age level increases, and that this is due to a process of increasing differentiation. The pattern indicates that the test assesses a more global language pattern at the lower age levels and a more differentiated and specific language pattern at the upper age levels.

For young children at the lower end of the standardization population age range, the assumption about "single abilities" is not tenable. However, factors which emerge at the older age levels tend to more closely approximate some of the dimensions the test was designed to assess. This suggests that for older age groups, the test may be getting closer to single ability assessment.

Table 3 presents between-age group comparison data for age groups which produced three factors each. There was heavy loading of Subtest 7 on a single factor for each of the three groups (see Factor Group A). Each of these factors could be considered a general language factor especially for the two older groups.

Insert Table 3 about here

Subtest 3 loaded heavily on a factor at each age level in Factor Group B. However, there were no other common subtests on the factors. The same pattern was

noted for Factor Group C, i.e., Subtest 2, loaded heavily on a factor at each age level, but there were no other common subtests on these factors. Comparison of t. factor structure at these age levels revealed little similarity or consistency.

In another examination of the age trend, Table 4 presents a comparison of three different populations at the 8-6 age level: the standardization population, the Center (1963) data, and the McCarthy and Olson (1963) data. The factor analyses of the three populations indicate important consistencies. All three populations present three factors which are relatively similar. Factor Group A is dominated by heavy loadings on the A-V-Auto and A-V-An Subtests. On the B

Insert Table 4 about here

Factor group ME loads heavily for all three groups and the VD and VE appears for two groups each. The factors of the C group are more random, but the V-M-An Subtest does load on each nevertheless. While the factor loadings are not identical, they are similar enough to indicate that different populations of children at similar age levels tend to produce similar factor structures on the ITPA. If further research continues to support consistency within age range, it could have important clinical use.

Having found few consistencies in the factor loadings of the ITPA between age levels to indicate that the test assessed a standard range of language abilities, the factor loadings for similarities which might reflect the language channels, levels, and processes which are so much a part of Osgood's language model for the test were examined. According to the communication theory on which the ITPA is based, language communication functions can be divided into three elements. In part, the test is an attempt to measure these language functions as individual and combined language processes. If the test actually does this, one would expect that a factor analytic study such as this would produce factors which reflect these language processes. Therefore factor loadings which reflect on the language functions of channels, levels, and processes are presented and analyzed.

Two channels are treated in the ITPA battery, the auditory-vocal channel and the visual-motor channel. Table 5 presents the factors and variable loadings which appear to reflect the functioning of either of the two channels. The factors included are those in which 75% or more of the variables which load at or

above the .50 level are on either the auditory-vocal channel or the visual-motor channel. All the other factors and factor loadings were either of a mixed variety indicating neither one channel or the other, or were loadings below the .50 level. The subtests which were included to measure the auditory-vocal channel are Subtests 1, 4, 6, 7, and 9; the other 2, 3, 5, and 8 are for the visual-motor channel.

Insert Table 5 about here

The results of subdividing the factors into these two subcategories indicated that there are some important channel consistencies in the test. Subtests 1, 4, 7, and 9 consistently load with one another throughout the various levels of the test. This would indicate that the auditory-vocal is to a certain extent a separate dimension of the test. The visual-motor channel also presents a relative amount of consistency. All of the subtests designed to measure this channel functioning do load with one another at some age levels. While the visual-motor channel is somewhat more variable than the auditory-vocal channel, the second subtest provides an important focal point for this channel dimension throughout the various age levels.

Of the 18 groups studied 15 produced at least one strong auditory-vocal factor and 13 produced at least one visual-motor factor. These facts suggest that the test does assess two channel dimensions with some validity.

The next step in the analysis was to compare the factor data according to communication levels. Table 6 presents the data which composes the two levels of the test: the representation level and the automatic-sequential level. The first level was measured by Subtests 2, 3, 4, 6, 8, and 9 and the second by Subtests 1, 5, and 7. The results indicated there are fewer consistencies using this method of subdivision than the channel method; nevertheless, the representational level does produce a relative amount of strength. The various subtests of

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Insert Table 6 about here

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of this level load with one another--though rarely at more than two at a time. It indicates that the representational level is not a single dimension, but rather a number of interrelated dimensions. On the other hand, the automatic-sequential level appears to present little in the way of substance. The subtest loads together on one factor only at age level 8-0. The lack of clear level

factors is particularly noticeable at the younger age levels. A partial explanation for this lack of clarity of level factors may be the fact that representational tasks of necessity involve automatic-sequential (memory) components. It is extremely difficult to devise a pure memory task with attempted channel restrictions which are not subject to alternative modes of solutions; for example, the V-M-S Subtest. Clinical observations indicate that many children use verbal labelling even when the examiner attempts to discourage it. Interestingly, four of the five factors emerging at the automatic-sequential level are dominated by the A-V-S Subtest.

The final step of analyzing the ITPA factor structure was subdividing the factors according to three language processes: decoding (Subtests 2 and 7); encoding (Subtests 3 and 6); and association-memory (Subtests 1, 4, 5, 7, and 8).

Table 7 indicates the decoding and association-memory processes have relative strength at the upper age levels. The decoding subtests appear together only at the 7-0 age level, but VD appears independently twice more and AD once more.

Insert Table 7 about here

Table 1 and the actual factor loadings reveal that VD loads very heavily (.80 or above), and loads moderately (.50 to .69) with one other subtest for the 6-0 (III) and 7-6 (III) age groups. AD shows a similar relationship for the 6-6 (IV), and 7-6 (IV) age groups. The association-memory processes are tapped by a wide range of subtests which tend to function as a unit at the upper age levels. At the 5-6 age level and up, two or more of the association-memory subtests appear together. The first factor loading at the 7-0 level is the most impressive (combining four of the five subtests). However, the randomness of the loadings at the other levels makes it clear that the association-memory processes cannot be considered as a single unitary dimension of the test.

The two encoding tests appear together as a separate factor at three age levels. Table 1 shows that they also load together at five other age levels but not entirely as a separate factor. From 6-6 on, they load together for each age level. It appears that the two encoding subtests do measure a similar, though not necessarily a completely separate, dimension.

The process analyses reveal the same pattern noted throughout the various analyses, i.e., differentiation is reasonably achieved for the older but not the younger age levels. This rather consistent finding suggests that the clinical use of the ITPA for younger children should be cautious. For older

children, it appears that the clinical utilization of the instrument is more justified.

The present study does not support the concept of nine "single abilities," but without the use of reference tests this would not have been possible. No study to date has supported this assumption (Ryckman, 1966).

Footnote

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Table 1

Number of Factors, Descending Subtest Ordering*, for Subtests Loading .50 or Greater and Percentage of Accountable Variance for Each Group Studied

Standardization Population Age Groups	FACTOR I	II	III	IV	V	Percentage Accountable Variance
2-6	2,6,1,3,5,8,4*	9,7,4	-	-	-	58.2
3-0	9,7,3,4,1	5,2,8,6	-	-	-	48.9
3-6	3,2,4,5	9,8,6,5	7,1	-	-	62.9
4-0	5,1,2,6,4	9,7	8,3	-	-	65.4
4-6	6,1,2,9	8,5,4	7	-	-	62.8
5-0	4,9,1	6,3	8,7	5,2	-	67.3
5-6	7,6,1,4	9,5,4	2,3,-8	-	-	72.5
6-0	3,9,1	7,4,6	2,-5	-	-	57.8
6-6	7,1,4	6,3	2,8	9,4	5	75.7
7-0	4,1,7,8	6,3,5	9,2	-	-	64.7
7-6	6,3,8	7,4	2,5	9,1	-	71.1
8-0	9,8,4	3,6	5,7,1	2	-	68.5
8-6	2,3,5,6	9,1,4	8,-7	-	-	60.7
9-0	1,5,8	2,3,6	9	7,-4	-	66.3
Center (1963)	7,4,1	8,2,5	3,6	-	-	58.1
McCarthy and Olson (1963)	1,4,7	2,3,8	5,6,8	-	-	54.1
Mueller (1965)	9,1,8	5,4,7,8	3,2	-	-	56.4
Semmel and Mueller (1963)	3,7,1,8,4,9	6,2,5	-	-	-	58.3

*Subtests are ordered according to size of loading on each factor, e.g., for age group 2-6, Factor I, Subtest 2 had the highest loading and Subtest 4 the weakest loading. The arabic numbers refer to the subtests in order of administration: 1 = Auditory-Vocal-Automatic (A-V-Auto); 2 = Visual Decode (VD); 3 = Motor Encode (ME); 4 = Auditory-Vocal-Association (A-V-An.); 5 = Visual Motor-Sequential (V-M-S); 6 = Vocal Encode (VE); 7 = Auditory-Vocal-Sequential (A-V-S); 8 = Visual-Motor-Association (V-M-An.); 9 = Auditory Decode (AD).

Table 2

ITPA Factors and Subtest Loading* for Three Representative Age Groups

Subtests	AGE GROUPS 3-0 FACTORS I	II	5-6 FACTORS I	II	III	8-0 FACTORS I	II	III	IV
1. Auditory - Vocal Automatic	.556		.614					.508	
2. Visual Decode		.697			.717				.910
3. Motor Encode	.607				.640		.895		
4. Auditory - Vocal Association	.578		.590	.516		.577			
5. Visual - Motor Sequencing		.775		.733				.792	
6. Vocal Encode		.561	.617				.824		
7. Auditory - Vocal Sequencing	.662		.906					.553	
8. Visual - Motor Association		.654			-.589	.638			
9. Auditory Decode	.663			.749		.844			

*Factor loadings at the .50 level and above are included.

Table 3

ITPA Factors and Subtest Loadings* for the Standardization Population of Three-Age Groups Which Produced Three Factors Each

	FACTOR GROUPS**								
	A			B			C		
	4-0,II	6-0,II	7-0,I	4-0,III	6-0,I	7-0,II	4-0,I	6-0,III	7-0,III
1. A-V-Auto			.814		.655		.755		
2. VD							.724	.819	.732
3. ME				.785	.698	.720			
4. AV Assn		.795	.863				.532		
5. VMS						.518	.769	-.640	
6. VE		.503				.789	.566		
7. A-V-S	.737	.821	.770						.807
8. V-M-An			.605	.788					
9. AD	.885				.675				

*Factor loadings at the .50 level and above are included.

**For ease of presentation, the factors are grouped according to similarity rather than actual order of appearance.

Table 4

ITPA Factors and Subtest Loadings* for Three Groups at Approximately the Same Age Level

Subtests	FACTOR GROUPS**								
	A			B			C		
	8-6 II	Center I	McCarthy I	8-6 I	Center III	McCarthy II	8-6 III	Center II	McCarthy III
1. A-V-Auto	.751	.773	.791						
2. VD				.818		.745		.672	
3. ME				.773	.787	.696			
4. AV Assn	.721	.746	.738						
5. VMS				.649				.603	.739
6. VE				.504	.779				.566
7. AVS		.773	.566				-.740		
8. V-M-Assn							.621	.674	.538
9. AD	.784								

*Factor loadings at the .50 level and above are included.

**For ease of presentation, the factors are grouped according to similarity rather than actual order of appearance.

Table 5

Factors on ITPA channels for Each Age Group

	CHANNELS	
	Auditory-Vocal (Subtests 1,4,6,7,9)	Visual-Motor (Subtests 2,3,5,8)
Age Group	Factors	Factors
2-6	II	
3-0	I	II
3-6	III	I
4-0	II	III
4-6	III	
5-0	I	IV
5-6	I	III
6-0	II	III
6-6	I;IV	III;V
7-0	I	
7-6	II;IV	III
8-0		IV
8-6	II	I;III
9-0	III;IV	
Center (1963)	I	II
McCarthy and Olson (1963)	I	II
Mueller (1965)		III
Semmel and Mueller (1962)		

Factors included - those which contain variables locating at the .50 level or above, 75% of which are appropriate to that channel.

Table 6

ITPA Level Factors for

Each Age Group Levels

Age Group	Representational (Subtests 2,3,4,6,8,9)	Automatic-Sequential 1,5,7
2-6		
3-0	II	
3-6	I;II	III
4-0	III	
4-6	I	III
5-0	II	
5-6	III	
6-0	III	
6-6	II;III;IV	V
7-0	III	
7-6	I	
8-0	I;II;IV	III
8-6	I;III	
9-0	II;III	IV
Center (1963)	III	
McCarthy and Olson (1963)	II	
Mueller (1965)	III	
Semmel and Mueller (1962)		

Factors included - those which contain variable loadings at the .50 level or above, 75% of which are appropriate to that level.

Table 7

ITPA Process Factors for

Each Age Group

Age Groups	PROCESSES		
	Decode (Subtests 2 & 9)	Encode (Subtests 3 & 6)	Association-Memory (Subtests 1,4,5,7,8)
2-6			
3-0			III
3-6			
4-0			II;III
4-6		II	III
5-0			I
5-6	III		
6-0		II	I;V
6-6	III		I
7-0			II
7-6	IV	II	III
8-0			III
8-6	III		I;IV
9-0		III	I
Center (1963)			I
McCarthy and Olson (1963)			II
Mueller (1965)			
Semmel and Mueller (1962)			

Factors included - those which contain variables loading at the .50 level or above, 75% of which are appropriate to the process.