

Relationships among Piagetian, IQ, and Achievement Assessments

Rheta DeVries

University of Illinois at Chicago Circle

DEVRIES, RHETA. *Relationships among Piagetian, IQ, and Achievement Assessments*. *CHILD DEVELOPMENT*, 1974, **45**, 746–756. Empirical relationships are explored among the theoretically different Piagetian and psychometric assessments of intelligence, and school achievement. Ss were 143 bright and average children chronologically aged 5, 6, and 7 years. Factor analyses of performance on the California Test of Mental Maturity (CTMM), Metropolitan Achievement Test (MAT), Stanford-Binet, and 15 Guttman-scaled Piaget-type tasks indicated that Piagetian, IQ, and achievement tests overlap to some degree, but also measure different aspects of cognitive functioning.

Belief in psychometric intelligence is so thoroughly ingrained in American psychology and education that hardly a school system or professional journal can command respect without taking account of IQ in educating or studying children. Recently, however, McClelland (1973) challenged the validity of IQ tests as measures of intelligence. His review of the literature led him to argue convincingly that the high correlations between IQ scores and various measures of occupational success or life adjustment are likely due to social class rather than to intelligence.

School achievement tests have also recently been under attack. Kohlberg and Mayer (1973) reviewed the literature and found that school achievement only predicts further school achievement and fails to predict anything else of value (such as occupational success).

The crumbling assumptions that an IQ

score represents intelligence and that school achievement prepares children for later success lead to a demand for alternatives in theory and practice. Kohlberg and Mayer (1973) suggest that Piagetian “cognitive stage measures provide a rational standard for educational intervention where psychometric intelligence tests do not” (p. 489). This alternative suggestion is congruent with McClelland’s (1973) less specific advocacy of tests with scores which “change as the person grows in experience, wisdom, and ability to perform effectively on various tasks that life presents to him” (p. 8). Therefore, the Piagetian alternative to psychometric methods seems worth examining.

The issue with regard to intelligence is: Are there theoretical and empirical differences between psychometric and Piagetian conceptions of intelligence? The issue with regard to school achievement is: Are there theoretical

This article is based on a paper presented at the annual meeting of the American Educational Research Association, New Orleans, March 1973. The study was supported by the Department of Program Development for Gifted Children, Illinois Office of Public Instruction, with supplemental support provided by the Office of Education, U.S. Department of Health, Education, and Welfare through the Chicago Early Education Research Center, a component of the National Laboratory on Early Childhood Education, and by the Urban Education Research Program and the Research Board of the University of Illinois at Chicago Circle. Computing services used in this research were provided by the Computer Center of the University of Illinois at Chicago Circle. Their assistance is gratefully acknowledged. The author would like to thank Dr. Arthur Turner and other personnel of the Unit 4 schools in Champaign, Illinois, for the many supportive services which facilitated the conduct of the study, and to thank the cooperating teachers, principals, and children of Champaign, Urbana, and Saint Joseph, Illinois. The author especially wishes to acknowledge the invaluable criticism and suggestions of Dr. Constance Kamii and Dr. Lawrence Kohlberg on earlier drafts of this article. Author’s address: College of Education, University of Illinois at Chicago Circle, Chicago, Illinois 60680.

and empirical differences between school achievement and knowledge measured by Piagetian tasks? This study is therefore concerned with the empirical relationships among the theoretically different Piagetian and psychometric assessments of intelligence, and school achievement. Let us first consider theoretical differences and related research findings.

Theoretical and Empirical Relationships between Psychometric and Piagetian Conceptions of Intelligence

IQ tests are not derived from any theory of intelligence but are based, instead, on certain assumptions about intelligence. IQ test-makers assume that the more correct answers the child gives relative to others of the same chronological age, the more intelligent he is. IQ is thus defined in terms of individual differences with regard to a wide variety of items which have no theoretical significance in themselves (that is, one cannot conclude anything about a child's general intelligence from his response to a single item). To a large extent, these items simply tap bits of surface information (such as the days of the week, the difference between a baseball and an orange, and perceptual discrimination of similarities and differences). Their surface nature is indicated by the fact that psychologists try so hard to keep their test answers secret in order to prevent "spuriously high" scores by individuals who simply learn the answers.

In contrast, Piaget's tasks are derived from (and have contributed to) a research-based theory of intelligence. Concerned with finding out what intelligence is rather than with quantifying it, Piagetian research has demonstrated universal, qualitative changes in the reasoning of humans from birth through adolescence. The theory accounts for these changes in terms of a gradual development of basic cognitive structure. Piagetian tasks are concerned with how the individual views and reasons about reality (for example, whether there are more blocks or more blue blocks, whether a quantity changes in amount when changed in shape, and whether one is a sister to one's sister). Each task has theoretical significance and in itself reveals something important about the individual's general development of his intelligence. Assessment is not concerned just with right answers but with kinds of wrong answers as well. Wrong answers are important for assessment because research

has shown that a child must go through many instances of being wrong before he finally constructs adult-level knowledge and intelligence. Thus, intelligence is defined by Piaget in terms of an individual's place in a universal sequence of development toward formal operational reasoning.

Research findings bearing on the relationship between psychometric and Piagetian intelligence are mixed. Relationships reported between Piagetian tasks and IQ are sometimes low (Beard 1960; Dodwell 1960, 1962) and sometimes moderate (Almy 1966, 1970; Dudek, Lester, Goldberg, & Dyer 1969; Elkind 1961; A. S. Honig, personal communication). Moderate correlations are usually reported between mental age and Piagetian performance (Freyberg 1966; Kohlberg 1963; Mannix 1960; Russell 1940a, 1940b). Factor-analytic studies generally indicate that Piagetian measures define factors separate from psychometric intelligence factors. Kohlberg and DeVries (in press) found three factors in the performance of bright and average 6-year-olds:

1. General psychometric intelligence (11 tests or subtests drawn from a variety of psychometric measures);
2. Conservation (Liquid, Length, Ring Segment);
3. Classification (Sorting and Class Inclusion).

Stephens, McLaughlin, Miller, and Glass (1972) found five interpretable factors in the performance of 150 normal and retarded children from 6 to 18 years of age:

1. Verbal (13 Wechsler and three Wide Range Achievement Test variables);
2. Piagetian reasoning (23 Piagetian measures), CA, MA;
3. Classification (four Class Inclusion tasks);
4. Spatial reasoning;
5. Performance (Wechsler Performance IQ and Object Assembly).

In a second study of the same Ss 4 years later, Stephens (1972) found the following seven factors:

1. Verbal (six Wechsler verbal subtests and three Wide Range Achievement subscores);
2. Conservation (Substance, Weight, Volume, Length, Liquid);
3. Performance (five Wechsler performance subtests);
4. Flexibility of thought processes (MA, CA, four Piagetian measures of spatial reasoning, relationships, and classification);
5. Classification (three Class Inclusion of Animals tests);
6. Mobility in dealing with concrete and abstract spatial relations (three tasks);

7. Transition from concrete to abstract operational thought (Dissolution of Sugar, Conservation of Weight and Volume, Class Inclusion of Animals, Transfer from Two to Three Dimensions, and Changing Mobile Perspectives).

Hathaway (1973), analyzing data collected by Dudek, Lester, and Goldberg, was able to identify three independent factors among 100 children 5–8 years of age:

1. WISC subtests;
2. Seven Piagetian tasks;
3. California Achievement Test subtests, some WISC subtests, and four Piagetian tasks.

The general picture presented by these findings is not clear but does suggest some degree of overlap and some degree of nonoverlap of psychometric and Piagetian measures of intelligence.

Theoretical and Empirical Relationships between School Achievement and Piagetian Conceptions of Knowledge

Piaget's view of knowledge is much broader than that reflected by school achievement tests. In the larger sense, Piaget views the development of knowledge and the development of intelligence as the same. In the narrow psychometric sense of achieving right answers to specific questions, Piaget (1964) points out that it is general cognitive development which makes specific learning possible. Since it is well known that achievement tests are highly correlated with IQ tests, the question arises of whether Piagetian and achievement assessments overlap. For example, does Piagetian number conservation predict arithmetic achievement?

The research literature contains little regarding the relationships among Piagetian measures and measures of psychometric achievement, but a few studies suggest that these assess different kinds of knowledge. In the Hathaway study described above, an achievement factor included some Piagetian tasks but was independent of a factor comprised of other Piagetian tasks. E. Ross (reviewed in Hathaway [1973]), studying 8- and 9-year-olds, found four Piagetian classification tasks to form a factor separate from

Reading Comprehension, Slosson IQ, and Paragraph Meaning. Hood (1962) studied the relationship between five grades of arithmetic competence (based on teachers' judgments) and three Piagetian stages on number-related tasks, and found that no child at the lowest level on one measure was at the highest level on the other; between these extremes, however, the relationship was not linear. Almy (1966) reports that for children 5–7 years of age, conservation of number and liquid are moderately correlated with reading readiness but correlated at a low or negative level with vocabulary. The general picture presented by these findings is also unclear but suggests some non-overlap between Piagetian and school achievement measures.

In order to clarify further the relationships among performance of young children on Piagetian tasks and psychometric tests of intelligence and achievement, the present study considers the following two questions: (1) To what extent do IQ tests and Piaget-type tasks measure the same intelligence? Specifically, how does Stanford-Binet mental age¹ (MA) relate to performance on Piaget-type tasks? Also, how does IQ on the California Test of Mental Maturity (CTMM) relate to performance on Piaget-type tasks? (2) To what extent do school achievement tests and Piaget-type tasks measure the same knowledge? Specifically, how does performance on Piaget-type tasks relate to performance on the Metropolitan Achievement Test (MAT)?

Method

Subjects.—The Ss were 143 white children, of bright, average, and retarded psychometric abilities (measured by performance on the Stanford-Binet Intelligence Scale), enrolled in the public schools of Champaign, Illinois (including some retarded pupils in Urbana and Saint Joseph, Illinois). High-IQ and average-IQ children were *chronologically* aged 5–7 years. Low-IQ Ss were *mentally* aged 5–7 years and *chronologically* aged 6–12 years. Table 1 shows the distribution and characteristics of the sample.

Procedure.—Fifteen Piaget-type tasks²

¹ Mental age is taken as the measure of psychometric intelligence on the Stanford-Binet test because it is defined in terms of increase with age and might therefore be assumed to correspond to Piagetian developmental changes.

² The battery is referred to as "Piaget-type" because some tasks are included which

TABLE 1
MEAN CA, MA, AND IQ OF BRIGHT, AVERAGE, AND RETARDED SUBJECTS ($N = 143$)

AGE GROUP AND CHARACTERISTICS	BRIGHT			AVERAGE			RETARDED ^a		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
5 years:									
<i>N</i>	8	8	16	9	8	17	8	5	13
CA ^b	5-5	5-8	5-7	5-6	5-6	5-6	7-10	7-4	7-8
MA ^b	6-10	7-5	7-2	5-10	5-9	5-9	5-6	5-3	5-5
IQ	130	133	132	108	105	106	69	67	68
6 years:									
<i>N</i>	8	8	16	8	9	17	8	8	16
CA ^b	6-6	6-6	6-6	6-7	6-5	6-6	8-6	8-9	8-7
MA ^b	8-2	8-2	8-2	6-10	6-11	6-10	6-4	6-5	6-5
IQ	129	129	129	104	107	105	74	72	73
7 years:									
<i>N</i>	8	8	16	8	8	16	8	8	16
CA ^b	7-7	7-7	7-7	7-9	7-7	7-8	9-11	10-1	10-0
MA ^b	9-8	9-9	9-9	7-11	7-11	7-11	7-5	7-6	7-6
IQ	130	130	130	101	105	103	75	74	75
Mean, all ages:									
<i>N</i>	24	24	48	25	25	50	24	21	45
CA ^b	6-6	6-7	6-7	6-7	6-6	6-6	8-9	8-11	8-10
MA ^b	8-3	8-5	8-4	6-10	6-10	6-10	6-5	6-7	6-6
IQ	130	131	130	104	105	105	72	72	72

^a Age group classification for this group is mental age, rather than chronological age.

^b Years and months.

were individually administered in three sessions totaling about 2 hours, as follows: session 1: Guessing Game (DeVries 1970), Conservation of Mass, Sibling Egocentrism, Left-Right Perspective, Constancy of Generic Identity (revised photograph form of the test described in DeVries [1969]), Class Inclusion; session 2: Conservation of Number, Constancy of Sex Identity (DeVries 1969; Kohlberg 1963), Conservation of Mass in the context of the ring-segment illusion (Jastrow effect), Dream Interview, Conservation of Length; session 3: Length Transitivity, Conservation of Liquid, Magic Interview (Kohlberg 1963), Object Sorting (Kohlberg 1963).

Scores on the California Test of Mental Maturity and the Metropolitan Achievement Test were obtained from school records and interpolated for time of Piagetian testing.

Analysis.—A Guttman scale was constructed for each of the Piaget-type tasks which met Green's (1956) criterion of an index of consistency greater than .50. Each scale also met Kohlberg's (1963) criteria for develop-

mental sequentiality. That is, mean scale scores increase with age, success on each scale item increases with age, and the sequence of items is justified by a logical rationale based on Piaget's theory. Each S was assigned a scale score on each task.

Factor analyses, using both the principal-component method and the principal-factor method, were performed with two groupings of variables: (1) Stanford-Binet MA and 15 Piagetian tasks ($N = 122$), and (2) Stanford-Binet MA, 15 Piagetian tasks, CTMM Language and Non-Language IQ, and four MAT subscores ($N = 50$). Both orthogonal and oblique rotations were performed. This was necessary because Piagetian tasks would be assumed to be related, and it is thus necessary to ascertain whether the restriction of orthogonality (independence) of factors distorts the factor picture.

Only Ss were included for whom data were complete on all variables. Since CTMM and MAT data were available on only 50 bright and average Ss, the first factor analysis was

Piaget never studied (Guessing Game, Constancy of Generic and Sex Identity, Ring Segment Conservation, and Magic). Nevertheless, these were inspired by Piaget's work and are similar in focus and method to Genevan tasks. Tasks and scoring are described in detail elsewhere (DeVries 1971).

performed in order to establish the patterning of Piagetian and mental age variables with a large sample which included the retardates. The second analysis could thus be validated against the first.

Results

For both groupings of variables, the oblique rotations revealed factor structures nearly identical with those of the orthogonal rotations. The principal-component and principal-factor methods also yielded essentially the same results. Therefore, the results below focus primarily on the outcome of the principal-component method with orthogonal rotations.

Factor analysis of Stanford-Binet MA and Piaget-type tasks.—Table 2 shows the intercorrelations among mental age and Piagetian tasks for the larger sample of 122 bright, average, and retarded Ss for whom all data were available. Low to moderate correlations were found between mental age and these tasks. Table 3 shows the results of the factor analysis. Three main factors emerged from the orthogonal rotation: a first conservation factor, accounting for one-third of the variance; a second factor containing most of the remaining Piagetian variables and MA; and a third identity factor. The oblique rotation showed the identity factor to be closely related to the conservation factor ($r = .36$). Three tasks (Sibling Egocentrism, Length Transitivity, and Object Sorting) form two other weak factors.

These results suggest that Stanford-Binet mental age is a poor predictor of performance on most of these Piaget-type tasks. Mental age related to performance on five tasks (Guessing Game, Left-Right Perspective, Magic, Class Inclusion, and Dream) but is independent of performance on Conservation, Identity, Sorting, Sibling, and Transitivity tasks.

This evidence indicates that intelligence as defined by Stanford-Binet mental age overlaps to a moderate degree with Piagetian intelligence, but that they are not identical. Therefore, the theoretical differences between Piagetian and psychometric intelligence do seem to correspond to real differences in cognitive measurement.

Factor analysis of Stanford-Binet MA, Piaget-type tasks, CTMM, and MAT.—Table 4 shows the intercorrelations among MA, Piagetian tasks, and MAT subtests for the sub-

TABLE 2
INTERCORRELATIONS AMONG STANFORD-BINET MA AND 15 PIAGET-TYPE TASKS FOR BRIGHT, AVERAGE, AND RETARDED CHILDREN (N = 122)

	MA	Guessing Game	Sibling Egocentrism	Generic Identity	Left-Right Perspective	Mass	Number	Sex Identity	Class Inclusion	Liquid	Length	Transitivity	Magic	Ring Segment	Sorting	Dream
MA	1.00															
Guessing Game	0.45	1.00														
Sibling Egocentrism	0.30	0.11	1.00													
Generic Identity	0.41	0.19	0.21	1.00												
Left-Right Perspective	0.44	0.29	0.11	0.05	1.00											
Mass	0.28	0.16	0.20	0.22	0.07	1.00										
Number	0.33	0.33	0.11	0.32	0.04	0.57	1.00									
Sex Identity	0.35	0.13	0.19	0.72	0.14	0.22	0.32	1.00								
Class Inclusion	0.59	0.26	0.14	0.27	0.30	0.09	0.24	0.27	1.00							
Liquid	0.40	0.29	0.26	0.35	0.06	0.61	0.62	0.30	0.21	1.00						
Length	0.35	0.22	0.12	0.34	0.05	0.44	0.62	0.34	0.20	0.54	1.00					
Transitivity	0.32	0.25	-0.05	0.14	0.18	-0.00	0.20	0.15	0.24	0.07	0.06	1.00				
Magic	0.56	0.24	0.18	0.37	0.25	0.23	0.30	0.40	0.49	0.30	0.28	0.15	1.00			
Ring Segment	0.60	0.28	0.26	0.44	0.32	0.41	0.55	0.45	0.35	0.56	0.56	0.43	1.00			
Sorting	0.00	0.18	0.11	0.06	-0.08	-0.00	0.02	0.01	0.06	0.12	-0.05	0.16	0.02	1.00		
Dream	0.58	0.35	0.13	0.38	0.28	0.19	0.44	0.36	0.40	0.40	0.44	0.19	0.44	0.04	1.00	

TABLE 3
 FACTOR MATRIX RESULTING FROM VARIMAX ROTATION OF STANFORD-BINET MA
 AND PIAGETIAN VARIABLES ($N = 50$)

	VARIANCE ACCOUNTED FOR BY:				
	Factor 1 (34.4%)	Factor 2 (11.1%)	Factor 3 (8.0%)	Factor 4 (7.3%)	Factor 5 (6.7%)
Stanford-Binet MA	0.28	0.79 ^a	0.25	0.08	0.10
Guessing Game	0.29	0.51 ^a	-0.09	0.42 ^b	-0.11
Sibling Egocentrism	0.12	0.21	0.14	0.18	0.82 ^a
Generic Identity	0.22	0.14	0.85 ^a	0.08	0.06
Left-Right Perspective	-0.04	0.76 ^a	-0.14	-0.13	0.05
Mass Conservation	0.79 ^a	0.03	0.00	-0.03	0.23
Number Conservation	0.84 ^a	0.14	0.16	0.09	-0.14
Sex-Role Identity	0.19	0.16	0.86 ^a	-0.01	0.02
Class Inclusion	0.05	0.68 ^a	0.25	0.08	0.00
Liquid Conservation	0.80 ^a	0.14	0.15	0.16	0.19
Length Conservation	0.76 ^a	0.13	0.25	-0.11	-0.09
Length Transitivity	0.04	0.36	0.12	0.43 ^b	-0.53
Magic	0.18	0.56 ^a	0.42 ^b	-0.02	0.10
Ring Segment Conservation	0.58 ^a	0.47 ^b	0.33	-0.01	0.01
Object Sorting	-0.02	-0.09	0.05	0.90 ^a	0.12
Dream	0.38	0.53 ^a	0.31	0.05	-0.11

^a The highest loading of the variable.

^b Secondary loading $> .40$.

sample of 50 bright and average 6- and 7-year-olds for whom all these data were available. Correlations are similar, though generally somewhat lower, in comparison to the correlations reported in table 2 for the larger sample. Table 5 shows the result of the factor analysis. Essentially the same grouping of Piagetian variables appeared as found for the larger sample, a finding which engenders confidence in the relationships found for the smaller and more restricted sample. The conservation and identity factors were especially stable. Four main factors emerged which accounted for 61.3% of the total variance. The first factor, accounting for one-third of the variance, included Stanford-Binet MA, CTMM Language and Non-Language IQ, Left-Right Perspective, Class Inclusion, and Magic (with substantial minor loadings of Ring Segment Conservation, Dream, and MAT Arithmetic). The second factor included all the conservation tasks and Sibling Egocentrism (with substantial minor loadings of the two identity tasks). The third factor was defined by the four MAT subtests and Dream. The fourth factor included the two identity tasks and Object Sorting. The minor fifth and sixth factors were defined, respectively, by Guessing Game and Length Transitivity.

The oblique rotation indicated that the first and second factors were related ($r = .33$), primarily because of the loading of Ring Segment Conservation on both factors. The first

factor was also related to the third factor ($r = .34$), primarily because of the loading of Stanford-Binet MA, MAT Arithmetic, and Dream on both factors. Figure 1 represents the relationships among the three main factors.

These results confirm the general finding of the analysis with the larger sample. Some overlap does exist between Piagetian and psychometric assessments. However, the overlap is limited, and Conservation, Identity, Sorting, Guessing Game, and Transitivity stand out as particularly different from psychometric mental age.

In addition, this result indicates that, with the exception of the Dream measure, no overlap exists between knowledge on Piaget-type tasks and school achievement knowledge as measured by the MAT. The correlation of only .20 between Number Conservation and Arithmetic achievement is particularly striking. Therefore, the theoretical differences between these two measures of knowledge also correspond to real differences in cognitive measurement.

Discussion

The results of this study are in general agreement with the findings of other factor-analytic studies of performance on Piagetian, IQ, and achievement tests. To a very large extent, Piagetian tasks do appear to measure a

TABLE 4

INTERCORRELATIONS AMONG STANFORD-BINET MA, 15 PIAGET-TYPE TASKS, AND FOUR MAT SUBTESTS, FOR BRIGHT AND AVERAGE CHILDREN (N = 50)

	MA	Guessing Game	Sibling Egocentrism	Generic Identity	Left-Right Perspective	Mass	Number	Sex Identity	Class Inclusion	Liquid	Length	Transitivity	Magic	Ring Segment	Sorting	Dream	MAT Word Knowledge	MAT Word Discrimination	MAT Reading	MAT Arithmetic
MA	1.00	0.00	0.31	0.35	0.46	0.20	0.26	0.31	0.54	0.28	0.19	0.37	0.58	0.56	-0.20	0.57	0.55	0.58	0.40	0.49
Guessing Game	0.00	1.00	-0.00	0.15	0.11	0.21	0.45	0.23	-0.13	0.23	0.09	0.19	0.03	0.18	0.14	0.18	0.01	-0.08	-0.01	0.08
Sibling			1.00	1.00	0.18	0.38	0.39	0.38	0.19	0.34	0.28	0.23	0.27	0.43	0.10	0.18	0.35	0.45	0.10	0.29
Egocentrism	0.31	-0.11	1.00	1.00	0.16	0.41	0.51	0.76	0.26	0.37	0.43	0.21	0.53	0.44	0.16	0.35	0.45	0.39	0.27	0.28
Generic Identity	0.35	0.15	0.29	1.00	0.18	0.38	0.39	0.76	0.26	0.37	0.43	0.21	0.53	0.44	0.16	0.35	0.45	0.39	0.27	0.28
Left-Right					1.00	0.21	0.21	0.13	0.37	0.13	0.11	0.19	0.27	0.41	-0.18	0.42	0.28	0.27	0.17	0.46
Perspective	0.46	0.11	0.18	0.16	1.00	0.21	0.21	0.13	0.37	0.13	0.11	0.19	0.27	0.41	-0.18	0.42	0.28	0.27	0.17	0.46
Mass	0.20	0.21	0.38	0.41	0.21	1.00	0.57	0.40	0.04	0.56	0.37	0.04	0.32	0.31	0.00	0.22	0.31	0.29	0.20	0.20
Number	0.26	0.45	0.39	0.51	0.21	0.57	1.00	0.55	0.11	0.60	0.64	0.23	0.32	0.59	-0.02	0.31	0.31	0.22	0.09	0.21
Sex Identity	0.31	0.23	0.38	0.76	0.13	0.40	0.55	1.00	0.24	0.33	0.37	0.16	0.45	0.45	0.12	0.11	0.40	0.37	0.17	0.15
Class Inclusion	0.54	-0.13	0.19	0.26	0.37	0.04	0.11	0.24	1.00	0.11	0.15	0.17	0.46	0.38	-0.01	0.26	0.32	0.32	0.24	0.41
Liquid	0.28	0.23	0.34	0.37	0.13	0.56	0.60	0.33	0.11	1.00	0.48	-0.02	0.25	0.46	0.11	0.30	0.31	0.28	0.07	0.33
Length	0.19	0.09	0.28	0.43	0.11	0.37	0.64	0.37	0.15	0.48	1.00	0.07	0.16	0.49	0.00	0.26	0.23	0.31	0.02	0.02
Transitivity	0.37	0.19	0.23	0.21	0.19	0.04	0.23	0.16	0.17	0.01	0.07	1.00	0.06	0.33	-0.01	0.33	0.25	0.35	0.22	0.22
Magic	0.58	0.03	0.27	0.53	0.27	0.32	0.32	0.45	0.46	0.25	0.16	0.06	1.00	0.48	0.04	0.39	0.35	0.34	0.26	0.30
Ring Segment	0.56	0.18	0.43	0.44	0.41	0.31	0.59	0.45	0.38	0.46	0.49	0.33	0.48	1.00	0.06	0.46	0.35	0.31	0.15	0.17
Sorting	-0.20	0.14	0.10	0.16	-0.18	0.00	-0.02	0.12	-0.02	0.11	0.00	-0.01	0.04	-0.06	1.00	0.05	0.04	0.17	0.09	0.18
Dream	0.57	0.18	0.18	0.35	0.42	0.22	0.31	0.11	0.26	0.30	0.26	0.33	0.39	0.46	0.05	1.00	0.62	0.57	0.33	0.60
MAT Word Knowledge	0.55	0.01	0.35	0.45	0.28	0.31	0.31	0.40	0.32	0.31	0.23	0.25	0.35	0.35	0.04	0.62	1.00	0.72	0.66	0.54
MAT Word Discrimination	0.58	-0.08	0.45	0.39	0.27	0.29	0.22	0.37	0.32	0.28	0.31	0.35	0.34	0.31	0.17	0.57	0.72	1.00	0.59	0.56
MAT Reading	0.40	-0.01	0.10	0.27	0.17	0.20	0.09	0.17	0.24	0.07	0.02	0.22	0.26	0.15	0.09	0.33	0.66	0.59	1.00	0.44
MAT Arithmetic	0.49	0.08	0.29	0.28	0.46	0.20	0.21	0.15	0.41	0.33	0.02	0.23	0.30	0.17	0.18	0.60	0.54	0.56	0.44	1.00

TABLE 5

FACTOR MATRIX RESULTING FROM VARIMAX ROTATION OF STANFORD-BINET MA, PIAGETIAN VARIABLES, CTMM NON-LANGUAGE AND LANGUAGE IQ, AND MAT SUBSCORES ($N = 50$)

	VARIANCE ACCOUNTED FOR BY:					
	Factor 1 (35.2%)	Factor 2 (12.5%)	Factor 3 (7.8%)	Factor 4 (5.8%)	Factor 5 (5.2%)	Factor 6 (5.0%)
Stanford-Binet MA	0.79 ^a	0.18	0.36	-0.09	-0.02	0.22
Guessing Game	-0.01	0.17	-0.03	0.16	0.87 ^a	0.15
Sibling Egocentrism	0.13	0.57 ^a	0.24	0.01	-0.17	0.16
Generic Identity	0.28	0.48 ^b	0.13	0.64 ^a	0.07	0.13
Left-Right Perspective	0.54 ^a	0.13	0.23	-0.27	0.23	0.11
Mass Conservation	0.07	0.73 ^a	0.16	-0.01	0.23	-0.24
Number Conservation	0.18	0.80 ^a	0.01	0.12	0.36	0.15
Sex Identity	0.24	0.52 ^b	-0.00	0.63 ^a	0.04	0.19
Class Inclusion	0.72 ^a	-0.01	0.16	0.18	-0.21	0.05
Liquid Conservation	0.07	0.75 ^a	0.22	0.05	0.19	-0.25
Length Conservation	0.07	0.77 ^a	0.03	0.12	-0.13	0.13
Length Transitivity	0.10	0.03	0.26	0.01	0.18	0.85 ^a
Magic	0.74 ^a	0.21	0.06	0.37	0.03	-0.14
Ring Segment Conservation ...	0.53 ^b	0.57 ^a	0.03	0.09	0.06	0.34
Object Sorting	-0.28	-0.10	0.30	0.63 ^a	0.19	-0.18
Dream	0.41 ^b	0.19	0.61 ^a	-0.06	0.27	0.15
MAT Word Knowledge	0.24	0.30	0.76 ^a	0.10	-0.06	0.13
MAT Word Discrimination ...	0.20	0.29	0.78 ^a	0.14	-0.20	0.20
MAT Reading	0.17	-0.02	0.73 ^a	0.12	-0.05	0.07
MAT Arithmetic	0.39	0.04	0.74 ^a	0.00	0.23	-0.12
CTMM Non-Language	0.80 ^a	0.14	0.31	0.02	-0.02	-0.02
CTMM Language	0.82 ^a	0.12	0.27	-0.08	0.12	0.07

^a The highest loading of the variable.

^b Secondary loading $> .40$.

different intelligence and a different achievement than do psychometric tests. This finding suggests examination of the nature of this difference and the implications for assessment of intelligence, for education, and for research on children.

Two primary differences can be noted between Piagetian and psychometric measures. First, they differ in their general perspective; and second, they differ specifically in how they assess intelligence.

The psychometric perspective takes a standard of normal intelligence closely related to school success. Psychometric intelligence is defined in terms of success on school-type items, and evidence of validity is frequently offered in terms of high correlations with school achievement. Cronbach (1960) even asserts that "the term 'intelligence test' is being replaced by such terms as 'test of general mental ability' or 'test of general scholastic ability'" (p. 164). Thus, the psychometric definition and perspective of intelligence are very narrow, defined by educational expectations of children.

In contrast, Piaget's definition of intelligence is not limited to school-type success but

takes the long-range perspective of the evolution of knowledge and intelligence in the individual. This evolution is described in terms of changes with age in the structure of knowledge. Thus, the Piagetian perspective is a broader one, defined by children's changing reasoning about reality.

In terms of how they try to measure intelligence, psychometric IQ tests assess how many correct answers a child can give in a highly structured situation. Reality is structured for the child, and, as McClelland (1973) has noted, what is required is respondent behavior, not the operant kind of behavior necessary in life situations where one cannot "choose between defined-in-advance responses" (p. 11). Basically, IQ tests measure, as Inhelder ([1943] 1968) pointed out, "the results of previous activities and acquisitions" (p. 44). These characteristics are also true of standardized achievement tests.

In contrast, Piaget's tasks focus on the child's reasoning behind his conclusions. These tasks confront the child with ambiguities of reality and ask him to impose his ideas on these ambiguities. Basically, this is an assessment of the structure of the child's logic in terms of its

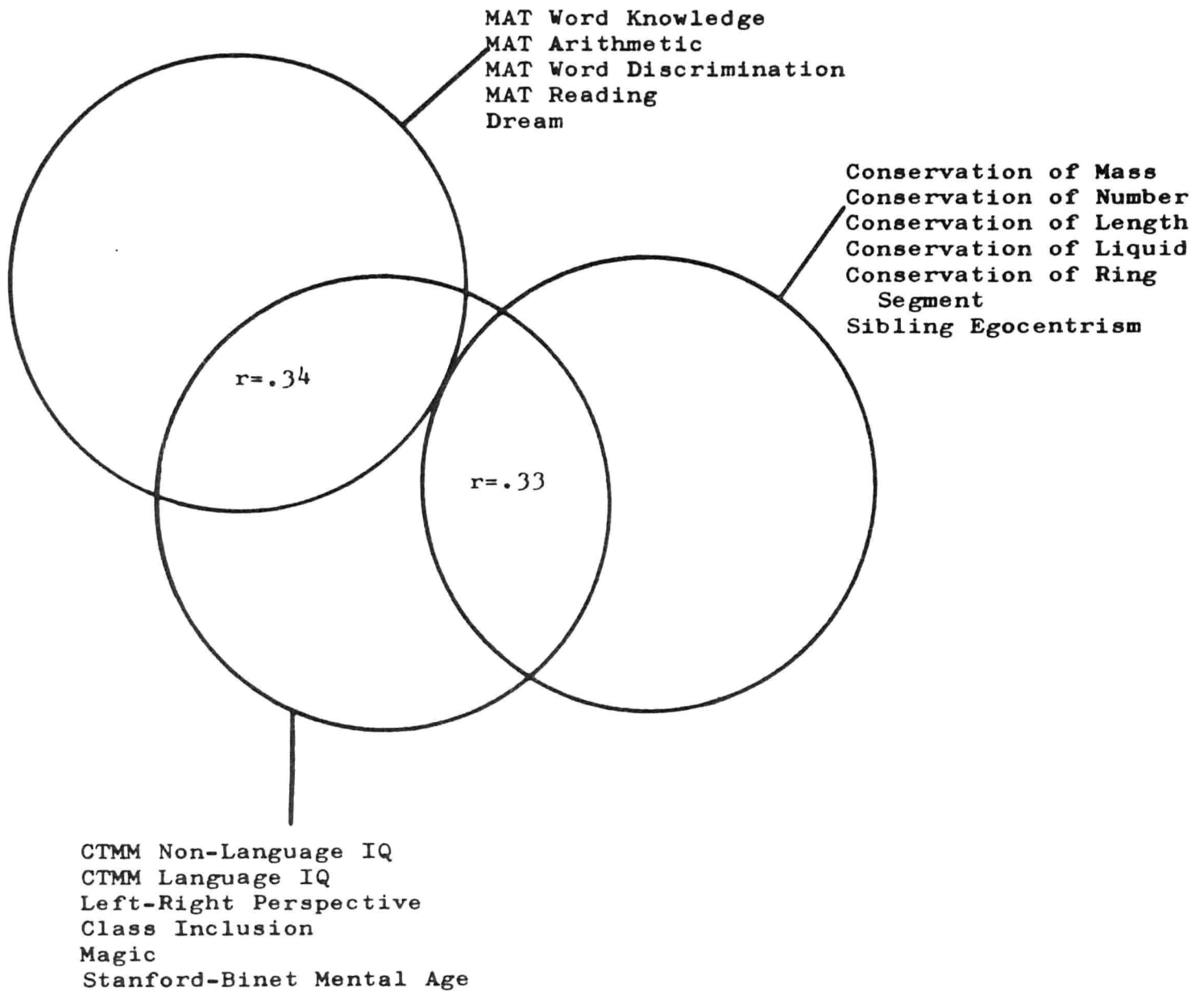


FIG. 1.—Diagram of primary factors defined by Piagetian, psychometric intelligence, and school achievement measures.

future development. The focus is upon the operations which make possible many specific acquisitions.

McClelland (1973) emphasized that what intelligence tests mainly predict are test-taking and symbol-manipulation competencies. Inhelder ([1943] 1968) commented that the Binet test gives a numerical sum of successes and failures, but that "it remains a very tricky problem to go further and conclude from this summation of results anything about the way the child arrived at them, the intellectual constructions that enabled him to do so, or the nature of the deficiencies from which his failures stemmed" (p. 45). Inhelder concluded that "although the Binet-Simon test is an excellent means for the rapid detection of mental anomalies, it cannot meet the demands of a psychological 'diagnosis' of thought" (p. 44).

Given these differences in perspective and

method, let us consider the implications for assessment of intelligence. The question is, What is the most valid measure of intelligence? Many challenges to the validity of IQ tests have already been mentioned. In addition, Inhelder ([1943] 1968) found that IQ tests are often faulty even in their assessment of permanent mental retardation, the purpose for which they were originally designed. Her study of children (and some adults) classified as retarded on the basis of IQ revealed that the IQ measures were not sensitive to differences between children who eventually became formal operational (but whose rate of development was slow) and true retardates who never progressed past the concrete operational stage. Piagetian tasks did differentiate between these two groups, though in some cases a diagnosis could not be made with certainty until adolescence. Later longitudinal study of retardates by Stephens (1972) indicates that many re-

tardates continue to progress through Piagetian stages even past the age of 20.

These findings suggest that IQ assessment often categorizes individuals as permanently retarded when, in terms of the development of reasoning, they are simply slow in their rate of development. (It may be that such inappropriate labeling even contributes to creating permanent retardation by relegating low-IQ children to educational situations which prevent or fail to promote their continued development.)

Piaget's tasks do seem to provide a theoretically and empirically more valid assessment of intelligence than psychometric measures. However, Piagetian tasks are not proposed as substitutes for psychometric tests. IQ tests probably do serve a purpose in providing, as Inhelder ([1943] 1968) suggested, a "first approximation" to assessment of a child's intelligence.

It should also be pointed out that even Piagetian tasks are limited in their ability to assess an individual's intelligence. At levels below the level of formal reasoning, it is tempting to try to evaluate individual children's strengths and weaknesses on Piaget's various tasks. However, such attempts would be mistaken primarily because particular patterns of comparative progress have no long-range predictive value. That is, the fact that a child is more advanced on physics problems than on mathematics problems has no long-range significance in terms of his general intelligence. However, the fact that he is more advanced in *some* area of reasoning may be significant. H. Sinclair (personal communication) relates that while retardates generally perform at the same level across all Piagetian tasks, normal children typically show advances in some areas. Sinclair speculates that such advances may create a disequilibrium which prompts dissatisfaction with lower-level thinking in other areas. Such dissatisfaction with lower-level reasoning is necessary before a child feels the need to construct something different. Sinclair also cautions that apparently established structures (pseudo-structures) may sometimes seem to disappear. For example, a child who previously conserved weight may give nonconservation responses when his focus shifts from weight to local pressure. We simply do not know enough about decalages on Piagetian assessments to draw firm conclusions about the intelligence of a child relative to

other children. Perhaps it is unrealistic to expect to be able to make valid fine-grained assessments of individual intelligence which have long-range predictive value.

Now let us turn to implications of this study for education. The finding that school achievement is almost entirely unrelated to the development of reasoning on Piagetian tasks suggests a reassessment of the overall objectives of education. The Piagetian perspective leads to the view that the aim of education should be the long-range development of the individual (not only cognitively, but emotionally, socially, and morally) (Kamii & DeVries, in press; Kohlberg & Mayer 1973). Academic achievement as an educational goal would then be reduced in proportion and placed in the larger developmental perspective.

It is not suggested that Piaget's tasks substitute for tests of a child's academic knowledge. Certainly tests of reading ability, computational skills, etc., have an appropriate place. However, their meaning becomes clearer when placed in the broader context of Piaget's theory of development.

Finally, what are the implications of this study for research on children? Virtually all contemporary studies take account of psychometric intelligence, and many studies actually are structured in such a way that other behaviors of children are viewed through the lens of the IQ. Such acceptance of the IQ as intelligence may obscure our possibilities for advancing our knowledge about child development. Serious reassessment of research methods and interpretation of findings which rest on IQ measures seems warranted.

References

- Almy, M. *Young children's thinking*. New York: Teachers College Press, 1966.
- Almy, M. *Logical thinking in second grade*. New York: Teachers College Press, 1970.
- Beard, R. M. The nature and development of concepts. *Educational Review*, 1960, 13, 12-26.
- Cronbach, L. J. *Essentials of psychological testing*. New York: Harper & Row, 1960.
- DeVries, R. *Constancy of generic identity in the years three to six*. *Monographs of the Society for Research in Child Development*, 1969, 34(3, Serial No. 127).
- DeVries, R. The development of role-taking as reflected by behavior of bright, average, and retarded children in a social guessing game. *Child Development*, 1970, 41, 759-770.

756 Child Development

- DeVries, R. Evaluation of cognitive development with Piaget-type tests: study of young bright, average, and retarded children. Urbana, Ill.: ERIC/ECE 075 065, 1971.
- Dodwell, P. C. Children's understanding of number and related concepts. *Canadian Journal of Psychology*, 1960, **14**(3), 191-205.
- Dodwell, P. C. Relations between the understanding of the logic of classes and of cardinal number in children. *Canadian Journal of Psychology*, 1962, **16**, 152-160.
- Dudek, S. Z.; Lester, E. P.; Goldberg, J. S.; & Dyer, G. B. Relationship of Piaget measures to standard intelligence and motor scales. *Perceptual and Motor Skills*, 1969, **28**, 351-362.
- Elkind, D. The development of quantitative thinking. *Journal of Genetic Psychology*, 1961, **98**, 36-46.
- Freyberg, P. S. Concept development in Piagetian terms in relation to school attainment. *Journal of Educational Psychology*, 1966, **57**(3), 164-168.
- Green, B. F. Method of scalogram analysis using summary statistics. *Psychometrika*, 1956, **21**(1), 79-88.
- Hathaway, W. E., Jr. The degree and nature of the relations between traditional psychometric and Piagetian developmental measures of mental development. Paper presented at the annual meeting of the American Educational Research Association, March 1973.
- Hood, H. B. An experimental study of Piaget's theory of the development of number in children. *British Journal of Psychology*, 1962, **53**(3), 273-286.
- Inhelder, B. *The diagnosis of reasoning in the mentally retarded*. 1943. New York: Day, 1968.
- Kamii, C., & DeVries, R. Piaget for early education. In R. Parker & M. Day (Eds.), *Preschool in action*. Boston: Allyn & Bacon, in press.
- Kohlberg, L. Stages in children's conceptions of physical and social objects. Unpublished monograph, 1963.
- Kohlberg, L., & DeVries, R. Relations between Piagetian and psychometric assessments of intelligence. In C. Lavatelli (Ed.), *The natural curriculum of the child*. Urbana: University of Illinois Press, in press.
- Kohlberg, L., & Mayer, R. Development as the aim of education. *Harvard Educational Review*, 1973, **42**(4), 449-496.
- McClelland, D. C. Testing for competence rather than for "intelligence." *American Psychologist*, 1973, **28**(1), 1-14.
- Mannix, J. B. The number concepts of a group of E.S.N. children. *British Journal of Educational Psychology*, 1960, **30**, 180-181.
- Piaget, J. Development and learning. In R. Ripple & V. Rockcastle (Eds.), *Piaget rediscovered*. Ithaca, N.Y.: Cornell University, 1964.
- Russell, R. W. Studies in animism, II: The development of animism. *Journal of Genetic Psychology*, 1940, **56**, 353-366. (a)
- Russell, R. W. Studies in animism, IV: An investigation of concepts allied to animism. *Journal of Genetic Psychology*, 1940, **57**, 83-91. (b)
- Stephens, W. B. The development of reasoning, moral judgment, and moral conduct in retardates and normals: phase II. Mimeographed. Temple University, 1972.
- Stephens, W. B.; McLaughlin, J. A.; Miller, C. K.; & Glass, G. V. Factorial structure of selected psycho-educational measures and Piagetian reasoning assessments. *Developmental Psychology*, 1972, **6**, 343-348.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.