

DIVERGENT THINKING ABILITIES—A VALIDATION STUDY

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SUMMARY. Verbal reasoning and semantic divergent thinking scores together with assessments of conventional and creative English attainment were gained for 331 10-year-old children. A factor analysis demonstrated a separation of the ability and attainment measures. A zonal analysis showed that highly divergent children gained better scores on the creative attainment criterion than did highly convergent children. The threshold hypothesis was tested by relating convergent and divergent thinking at different levels of VRQ, and was rejected. Evidence concerning construct and academic validity is discussed.

INTRODUCTION

Guilford and Hoepfner (1971) distinguish two types of validity in relation to semantic divergent thinking abilities, construct validity, which involves the use of a creative criterion, and academic validity, which relates to conventional achievement measures.

Tests of divergent thinking have tended to become synonymous with tests of creativity in the research literature. However, Nuttall (1972) points out that for every ten studies which have used the tests and accepted their validity, only one attempted an empirical validation against creative criteria, and few met with any success. McNemar (1964) and Cronbach (1970) have also criticised the lack of evidence about validity, the former stating that "there is no evidence whatsoever that the tests have predicted value for non-test real-life creative performance." In his review of this area Shapiro (1968) claimed that the basic problem is the lack of objective criteria. "Without establishing objective criteria, all endeavours at devising predictors, investigating personality and cognitive characteristics . . . are of questionable value."

Studies which have attempted to validate these tests in the field of education have often used teacher or peer ratings of pupil creativity, a criterion which Wallach and Kogan (1965) claim is 'next to worthless' because of subjectivity and halo effect. Merrifield, Guilford and Gershon (1963) found correlations between -0.04 and 0.42 between teacher ratings and divergent abilities at sixth grade level, and Haddon and Lytton (1971) report a correlation of 0.29 at secondary level. Lovell and Shields (1967), Moss and Duenck (1967) and Dewing (1970) all report low relationships.

Convincing construct validity would therefore appear to be lacking, due mainly to the dearth of objective criteria. It could be argued that current emphasis on creative activity in primary education provides a criterion which is worthy of consideration in this context, namely creative, or imaginative, story writing. Guilford (1959) has suggested that the abilities required for successful writing are those constituting the semantic divergent block of his 'structure of intellect' model. Only Rudd (1970) appears to have published a study which investigated this relationship using Guilford's tests. These were related to tests of written expression, involving the use of imagination, in a sample of 113 CSE candidates. A factor was identified with moderate to high loadings from both sets of measures. Unfortunately, the correlation matrix was not published.

Research concerning academic validity has been equivocal on both sides of the Atlantic. In Britain Hasan and Butcher (1966) reported correlations of 0.62 with English, and 0.76 with arithmetic, but Richards and Bolton (1971) concluded that divergent abilities played only a minor role in mathematics attainment. In the United States divergent abilities have been related to attainment in science (Cline, Richards and Needham, 1963), mathematics (Petersen, Guilford and Hoepfner, 1963) and to general achievement batteries (Ohnmacht, 1966), but results have again been conflicting.

A number of factors have been put forward to explain this conflict, the one receiving most attention being the relationship between convergent and divergent abilities. Getzels and Jackson (1962) and Wallach and Kogan (1965) claimed that creativity (divergent thinking) and intelligence could be considered separate modes of intellectual functioning. Their samples were highly atypical however, and it has since been found that correlations between these abilities tend to be higher among samples more representative of the whole ability range. The moderately high correlations reported by Hasan and Butcher (1966) and Haddon and Lytton (1968) lend support to this.

It has also been found that different relationships exist at different levels of VRQ. Guilford and Hoepfner (1966a) found that those who score low on divergent tests can range widely on VRQ, but those who score highly on divergent tests also score highly on VRQ. This is implicit in the threshold hypothesis (McKinnon, 1962) which postulates that a minimum level of intellectual ability is necessary for a high level of divergent ability, but above a certain level, commonly held to be VRQ 115+, little relationship exists between divergent ability and VRQ. Studies which have investigated this have again been equivocal (Haddon and Lytton, 1968; Lytton and Cotton, 1969; Cicirelli, 1965).

The present study attempts to clarify a number of the problems outlined above by the examining of the relationships between—

- (1) Semantic divergent thinking abilities and assessments of imaginative stories, to gain evidence of construct validity.
- (2) Divergent abilities and conventional English attainment to gain evidence concerning academic validity.
- (3) Divergent and convergent (VRQ) abilities, to assess the unitary nature of divergent thinking abilities.
- (4) Divergent and convergent abilities at different levels of VRQ to assess the threshold hypothesis.

METHOD

The sample consisted of 331 children (164 boys and 167 girls) of mean age 10 years 3 months, drawn from 11 classes in eight schools. The geographical distribution of these schools ensured that the sample was representative in terms of social class and intelligence levels. The mean VRQ was 104.8, standard deviation 17.0. The following measures were obtained.

Attainment.

- (1) Rank orders in formal English obtained from end of term tests. These were scaled against the verbal reasoning test to allow comparison across classes (Yates and Pidgeon, 1957).
- (2) Assessments of imaginative stories. Two teachers, not involved in the study, gave impression marks for the use of imagination, good ideas and so

on, ensuring that poor spelling and grammar were not penalised. The score allotted was the sum of two seven-point ratings. Mark, re-mark and inter marker correlations both exceeded 0.70.

Abilities.

- (3) Convergent. Verbal Reasoning Test. (Primary Verbal 3. NFER).
- (4) Divergent. 10 tests of semantic divergent thinking abilities taken from Guilford and Hoepfner (1966b). To increase reliability two tests were given for each of the following abilities—ideational fluency, spontaneous flexibility, associational fluency, originality and expressional fluency. A word count of the story provided an additional measure of word fluency. Each ability score was the average of the two test scores after each had been standardised by conversion to T scores. A composite score of semantic divergence was also computed, this being the average of the five ability scores.

RESULTS

Table 1 presents the correlation matrix separately for each sex. The correlations among the tests of divergent ability range from 0.36 to 0.74, which are somewhat higher than their correlation with verbal reasoning, which range from 0.26 to 0.50. The composite score of semantic divergence correlated with verbal reasoning 0.54 and 0.58 among boys and girls, respectively. These are similar to the values obtained by Haddon and Lytton (1968), but lower than those gained by Hasan and Butcher (1966).

TABLE 1
INTERCORRELATIONS OF ABILITY AND ATTAINMENT MEASURES, BY SEX.

	1	2	3	4	5	6	7	8	9	10
1. Imaginative story (fluency)										
2. Imaginative story (mark)	56									
3. Verbal reasoning	41	50								
4. English	45	51	90							
5. Ideational fluency	25	27	31	30						
6. Spontaneous flexibility	23	32	47	41	72					
7. Associational fluency	30	40	32	33	53	12				
8. Originality	35	47	41	41	48	49	40			
9. Expressional fluency	38	38	50	50	36	43	45	40		
10. Semantic divergence	43	53	58	57	80	80	72	73	70	

Girls above diagonal (N=167); boys below diagonal (N=164).
Significance levels: 0.15 < .05, 0.20 = P < .01, 0.28 = P < .001.

The intercorrelations of individual divergent abilities and the imaginative story, although highly significant, were no larger than their correlation with the conventional English score. In fact, semantic divergence correlated slightly more highly with English than with the creative criterion. The difference between convergent ability and the two criterion measures is more marked. Verbal reasoning correlated nearly 0.90 with English, but 0.50 with the story, although the former relationship could have been artificially increased by the scaling procedure.

To clarify the relationship factor analyses were computed separately for each sex. Since these were almost identical the factor structure for the whole sample is reported. Three factors with eigen values in excess of unity emerged,

accounting for some 72 per cent of the variance. The analysis, after a varimax rotation to simple structure, is presented in Table 2. Factor one clearly indicates convergent ability and conventional attainment. Factor two delineated the semantic divergent abilities with a maximum loading on ideational fluency. The variance of the tests of originality and expressional fluency is spread to other factors, the former to factor three and the latter to factor one. Factor three isolates the imaginative story, on which three divergent abilities have low to moderate loadings. The high loading of the story fluency measure indicates that longer stories tended to gain higher marks.

TABLE 2
FACTOR LOADINGS AFTER VARIMAX ROTATION.

	1	2	3
1. Imaginative story (fluency)			84
2. Imaginative story (marks)	31		77
3. Verbal reasoning	91		
4. English	90		
5. Ideational fluency		90	
6. Spontaneous flexibility		82	
7. Associational fluency		70	30
8. Originality		51	47
9. Expressional fluency	39	52	28
Rotated percentage variance	29.1	25.5	17.7

Decimal points and loadings less than .30 have been omitted except where the values are useful for comparison.

Convergent and divergent abilities.

The relative contribution of the two ability measures to the two attainment measures can be assessed by a zonal analysis. Scores on the verbal reasoning test and the composite measure of semantic divergence were divided into high, average, and low groups by splitting the distributions at half a standard deviation above and below the mean. This results in nine cells. For each cell the mean scores on the story and the conventional English measure were computed. These are shown in Table 3.

TABLE 3
MEAN SCORES ON CONVENTIONAL AND CREATIVE ATTAINMENT AT DIFFERENT LEVELS OF DIVERGENT AND CONVERGENT ABILITY.

	CONVENTIONAL ATTAINMENT				IMAGINATIVE STORY			
	Semantic Divergence				Semantic Divergence			
	High	Mid	Low	All	High	Mid	Low	All
High V.R. (113+)	56.4 (61)	49.6 (34)	46.7 (10)	53.3 (105)	10.3	6.6	6.1	8.7
Mid V.R. (97-112)	36.8 (38)	34.3 (42)	31.2 (32)	34.3 (112)	7.7	7.1	5.7	6.9
Low V.R. (96-)	26.9 (11)	22.1 (42)	15.4 (61)	19.0 (114)	7.9	5.7	3.7	4.8
All	46.7 (110)	34.4 (118)	23.3 (103)	35.0 (331)	9.2	6.5	4.6	6.8

The numbers in each cell are shown in parentheses.

Not surprisingly those children who gained high scores in both ability measures excelled in both criterion measures, although children with high divergent ability tended to gain higher scores on the story than did those with high convergent ability. Also of interest is the fact that children who gain high divergent scores, but average or low convergent scores, gained significantly higher marks than those with high convergent, but low or average divergent scores. Both these relationships are clearly reversed when the conventional English measure is considered.

The number of children appearing in each cell is also shown in Table 3. If Guilford's premise concerning the relationship of convergent and divergent abilities is correct, then the numbers in the three low divergent cells should be randomly distributed. In the high divergent cells a significantly greater number should appear in the high convergent/high divergent cell, and least in the high divergent/low convergent cell. Only the latter part of the premise is borne out by the results. 61 children were classified high on both ability measures, reducing to 11 children classified high divergent/low convergent. This same pattern is evident in the low divergent column but in reverse order. In brief, a high level of convergent thinking ability is associated with a high level of divergent thinking, and *vice versa*.

To test the threshold hypothesis the sample was grouped by VRQ level and by sex. The correlation of each group with semantic divergence is shown in Table 4.

TABLE 4

CORRELATIONS BETWEEN VRQ AND SEMANTIC DIVERGENCE BY LEVEL OF VRQ AND SEX.

Girls	VRQ Range	N	r	Boys	VRQ Range	N	r
High V.R.	115+	53	.38	High V.R.	113+	52	.26
Av. V.R.	99-114	59	.31	Av. V.R.	96-112	58	.03
Low V.R.	98-	55	.39	Low V.R.	95--	54	-.49

Although a sex difference exists in the average levels of VRQ, the general picture is clear. Although the correlations at lower levels of VRQ tend to be slightly larger, there is no evidence of a threshold effect operating.

DISCUSSION

Hasan and Butcher argued that the intercorrelations of individual divergent thinking abilities are often of similar magnitude to their correlations with verbal reasoning. Implicit in this view is that the likelihood of separation in a factor analysis is remote. The present study does not confirm this and Guilford (1968) has, in fact, pointed out a fallacy in this line of argument. He maintains that it is invalid to contrast correlations between individual divergent abilities and a verbal reasoning score. Since the latter is composite of several subtests of convergent thinking, any individual ability measure is likely to correlate more highly with it because composite measures are able to share more sources of variance.

Guilford's premise concerning the relationship of convergent and divergent thinking was only partially supported. The cell populations in Table 3 make it clear that the relationship is consistent and fairly close at each ability level. Only 3 per cent of the sample combined low convergent scores with evidence of high divergence, and a similar percentage combine low divergence with high convergence. In contrast 18 per cent of the sample gained high scores on both ability measures, a category ignored by Getzels and Jackson. The threshold hypothesis was also contradicted. Although the correlations between the two ability measures were slightly higher at lower level of VRQ, correlations of between 0.26 and 0.38 were apparent at high levels of VRQ. It could, of course, be argued that the correlation would be lower at levels of VRQ higher than those adopted in this study.

The factor analysis demonstrated a separation of divergent abilities, convergent abilities/conventional attainment, and creative attainment. Ideational fluency, spontaneous flexibility and associational fluency loaded most strongly on the divergent thinking factor, but the variance of the tests of originality and expressional fluency spreads to other factors. Originality loaded moderately on the imaginative story factor, reflecting no doubt the emphasis teachers place on this ability in their impression marking. This seems to indicate an overlap between originality as measured by objective tests and teacher ratings of creative attainment. Expressional fluency loaded moderately on the conventional attainment factor. The tests for this ability consist of constructing sentences in which specified words must appear. It is reasonable to assume that verbal proficiency plays a larger part in this type of test.

Evidence for construct validity is provided by the fact that three semantic divergent abilities load on the story factor. The zonal analysis added further evidence by showing that highly divergent children score better marks on average than highly convergent children. The performance of those children with high divergent scores but moderate or low levels of convergent ability also lends support to the premise that divergent abilities contribute more to such attainment than do convergent abilities. There appears less evidence of academic validity. The correlations between divergent abilities and conventional English were all significant, ranging from .3 to .5, but only one loaded on the conventional attainment factor.

Although the results help to clarify some of the relationships outlined in the introduction, no complete answers are possible. The evidence concerning the construct validity of semantic divergent abilities is encouraging, but it does not provide any justification for treating such abilities as synonymous with creativity.

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