

## CHILDREN'S PRODUCTION ON VERBAL AND NON-VERBAL FLUENCY TASKS<sup>1</sup>

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*Summary.*—Children aged 6 to 13 yr. were given verbal and non-verbal fluency tasks as well as the Vocabulary and Block Design subtests of the WISC-R. The results, providing normative data, showed that the fluency tasks are age-, but not sex-dependent, and are only modestly correlated to one another and to standard measures of intelligence.

Recently evidence has begun to accumulate for the functional specialization of the frontal lobes<sup>5</sup> (Jones-Gotman & Milner, 1977); see Moscovitch (1979) for a review. Lesions in the left hemisphere impair performance on verbal fluency tasks but spare non-verbal productivity. By contrast, right-hemisphere lesions result in defective performance on non-verbal-fluency tasks. This study was done to provide normative data on such tasks for children as such information may prove useful to the clinician, permitting detection of dysfunction early in development. The present tasks were identical to those used with brain-damaged adults. We recognize that the terms verbal and non-verbal are relative ones. In the current study the terms refer to the types of stimuli used and not necessarily to type of processing employed by the subjects. In addition, the Vocabulary and Block Design subtests of the WISC-R (Wechsler, 1974) were given to assess the degree to which the experimental measures are influenced by intelligence. These subtests were chosen since they correlate highly with over-all intelligence (Matarazzo, 1972).

### METHOD

#### *Subjects*

Eighty children at the Fairburn Elementary School in Victoria volunteered to participate in the study. There were 10 boys and 10 girls in each of four grades. The mean age (yr.) of children in Grade 1 was 6.3 yr.; in Grade 3, 8.4; in Grade 5, 10.6, and in Grade 7, 12.4. All were right-handed. Writing

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<sup>5</sup>Dissociation in right and left frontal lobe function in repetitive behavior. (Unpublished paper)

hand was determined by the teachers' report and verified by observing each child use a writing implement. None had failed a grade, and none had a history of psychiatric or neurological disorders.

### Procedure

*Non-verbal Fluency: Five-point Test.*—The procedure described by REGARD and PERRER<sup>5</sup> was used. The test (see Fig. 1) items appear on a sheet, partitioned in rectangles. Five symmetrically arranged black dots are printed in each rectangle. The subjects were asked to produce as many different figures as possible within 5 min. by connecting the given dots in each rectangle with straight lines. The subject was informed that not all the dots had to be used. Each subject was instructed not to repeat figures or draw lines which did not connect dots. One warning was given on the first occurrence of an infraction of each of these rules. Rules were not repeated on any further infractions. At the start of the test, two sample solutions were drawn by the examiner.



FIG. 1. Example of Five-point Test sample sheet. The complete sheet consisted of 40 rectangles of 4 by 3 cm arranged in 8 rows and 8 columns.

The variables scored were (1) the total number of figures, (2) the number of repetitions, (3) the number of rotated figures, (4) the number of figures using added dots, (5) the number of self-corrections, and (6) the percent correct.

*Verbal Fluency: (1) F Test.*—The subject was asked to produce within 1 min. as many different words as possible that begin with the letter "F". Subjects were instructed not to produce proper nouns or repeat words. The examiner wrote down the words spoken by the subject.

(2) *Animal naming.*—Because reading skill may affect performance on the F test, we also asked children to produce as many different animals as possible within 1 min. (Goodglass & Kaplan, 1972). There is, however, some clinical evidence for adults which indicates that this 'semantic' fluency task is affected by left temporal lesions whereas normal performance on the 'phonetic' fluency task requires an intact left frontal lobe (Newcombe, 1969).

The following variables were scored for each of the verbal fluency tasks: (1) total number of words produced, (2) the number of repetitions, (3) the number of non-words (e.g., fliz), and (4) the number of words beginning with the wrong letter or drawn from an incorrect category, e.g., fruit instead of an animal.

The Vocabulary and Block Design subtests of the WISC-R were given and raw and scaled scores were tabulated.

All tests were given in a randomized order by examiners unfamiliar with the hypotheses being tested.

# RESULTS

Multivariate and univariate analyses of variance (Clyde, 1970) were conducted, with grade and sex treated as between-groups factors. To determine which means differed significantly from one another, Duncan's multiple-range test was used ( $p_{.05}$ ).

The multivariate test for grade yielded a significant over-all effect using Wilk's  $\lambda$  (root 1-3;  $F_{3,72} = 6.78, p < .001$ ). The multivariate and univariate tests for sex and the interaction grade  $\times$  sex produced no significant effects. Univariate tests for grade yielded significant effects on all tests.

On the Five-point Test grade affected the total number of figures produced ( $F_{3,72} = 16.47, p < .001$ ). Table 1 shows that total production increased significantly between grades from 1 to 7 (critical difference = 6.41). The number of rotated figures also increased from Grades 1 through 7 ( $F_{3,72} = 19.8, p < .001$ ), with significant differences between Grades 1 and 3 and 5 and 7. There was no difference between Grades 3 and 5 (critical difference = 3.32). Grade also affected the number of self-corrections ( $F_{3,72} = 3.07, p = .03$ ). As Table 1 shows, self-corrections rarely occurred in children below Grade 5 (critical difference = .33). Finally, there were no significant effects for the number of repeated designs, figures using added dots, and percent correct.

Grade (age) significantly affected the number of words produced beginning with the letter "F" ( $F_{3,72} = 11.05, p < .001$ ). Total production increased significantly at each grade although the difference between Grades 5 and 7 did not reach significance (critical difference = 1.92). Production of animal names also increased significantly with grade ( $F_{3,72} = 11.41, p < .001$ ). Again, the difference between Grades 5 and 7 was nonsignificant (critical difference = 2.2). Non-words occurred only in Grade 1 ( $F_{3,72} = 2.88, p = .04$ ).

Block Design raw scores also increased with grade (age) ( $F_{3,72} = 22.64, p < .001$ ). Scaled scores did not differ between grades ( $M = 11.4$ ). The raw Vocabulary scores increased significantly with age ( $F_{3,72} = 46.21, p < .001$ ). The scaled scores did not differ between grades (ages) ( $M = 10.6$ ).

The various fluency measures were correlated with one another but the amount of variance unexplained was rather large (more than 70%), suggesting the verbal and non-verbal fluency measures tap similar though not identical functions. The measures of fluency also showed a modest correlation with the WISC-R subtests (approximately  $r = .44$ ).

TABLE 1  
MEANS AND STANDARD DEVIATIONS FOR GRADE AND SEX

Group	n	Figures		Five-point Test				F Test				Animal Naming		Block Design		Vocabulary		
		M	SD	Rotated Figures	Self- corrections	Words		Non-words		Words		Raw Scores		Raw Scores				
						M	SD	M	SD	M	SD	M	SD	M	SD			
Grade/Sex				M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	
1		20	22.48	12.56	5.90	3.89	.10	.31	5.80	2.65	.20	.52	10.05	3.25	15.15	5.86	17.05	5.72
	Girls	10	20.47	12.47	6.30	4.76	.10	.32	6.60	2.80	.10	.32	9.10	3.31	13.20	5.69	16.00	3.37
	Boys	10	24.50	12.96	5.50	2.99	.10	.32	4.90	2.33	.30	.67	11.00	3.06	17.10	5.63	18.10	7.43
3		20	30.10	9.92	10.90	4.34	.05	.22	8.45	3.30	.00	.00	13.40	3.00	28.60	8.46	27.40	5.30
	Girls	10	27.10	7.52	11.70	4.57	.00	.00	8.00	2.26	.00	.00	13.70	2.83	28.30	9.75	28.20	5.51
	Boys	10	33.10	11.46	10.10	4.18	.10	.32	8.90	4.18	.00	.00	13.10	3.28	28.90	7.46	26.60	5.23
5		20	37.35	8.99	13.25	5.82	.50	.69	10.20	3.07	.00	.00	15.70	4.02	29.15	11.05	34.55	6.17
	Girls	10	36.40	7.63	11.00	3.92	.40	.52	10.30	2.79	.00	.00	14.60	4.27	27.40	9.41	34.40	5.93
	Boys	10	38.30	10.50	15.50	6.70	.60	.84	10.10	3.48	.00	.00	16.70	3.65	30.90	12.74	34.70	6.72
7		20	44.00	8.71	18.60	6.79	.35	.67	10.90	3.27	.00	.00	15.70	3.69	40.90	12.45	36.75	5.68
	Girls	10	45.00	9.09	17.50	7.43	.20	.42	12.00	3.27	.00	.00	16.00	2.54	43.00	14.91	37.00	4.90
	Boys	10	43.00	8.68	19.70	6.27	.50	.85	9.70	2.98	.00	.00	15.40	4.70	38.80	9.76	36.50	6.64

# DISCUSSION

For members of both sexes, the number of productions in the non-verbal fluency test increased linearly so that children, aged 10 yr. and older, performed at a level comparable to that of normal adults.<sup>5</sup> There were qualitative differences as well. Only the 10- and 12-yr.-olds tended to monitor their productions. This cognitive control was evident in the increased occurrence of self-corrections.

Although non-verbal fluency increased with age, even the very youngest children tested generated on the average more designs ( $M = 22.8$ ) than did brain-damaged adults with verified focal lesions ( $M = 19.3$ ).

Verbal fluency also increased with age and approached, but did not yet attain, adult levels by about age 10 yr. (Benton, 1973; Borod, Goodglass, & Kaplan, 1980).

There are cross-sectional data which indicate sex-related changes in verbal and non-verbal fluency tasks in the adult (Borod, Goodglass, & Kaplan, 1980; Verhoff, 1980; Benton, *et al.*, 1981; Ermini, 1982). The failure in the present study of a young sample to find such effects of gender suggests that sex-related differences may reflect the operation of generational influences. Both cross-sectional and longitudinal studies are needed to establish the developmental course for both verbal and non-verbal functions.

In summary, production on the verbal and non-verbal fluency tasks is age- but not sex-dependent. The tasks are related only modestly with one another and measures of intelligence. Further, the fluency tasks require little time and effort to administer and score and may prove useful in assessing adults and children with neurological disorders.

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