

PATTERNS OF CORRELATIONS FOR VARIOUS LANGUAGE  
MEASURES IN MOTHER-CHILD INTERACTIONS FOR  
NORMAL AND DOWN'S SYNDROME CHILDREN\*

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Forty-two normal and Down's syndrome children and their mothers were observed while interacting at home in a free-play situation. The linguistic level of the children as assessed by mean length of utterance ranged from 1.00 to 3.00. Quantitative aspects of the verbal interaction were analysed. They were found to vary with the language level of the children. Correlational analyses confirmed the validity of MLU as a reflection of formal complexity in children's speech and in mothers' speech directed to their children. The data were related to other recent studies on the same topic.

It is common knowledge that mothers provide language input highly suited to their language learning children (Mahoney and Seely, 1976, for a review). Despite the respectable size of this literature, there is still little understanding of the mechanisms underlying this accomplishment.

As a first way of approaching the question, Moerk (1975) suggested investigating the interrelationships between various types of language behaviour of children and their mothers by means of correlational studies. Along this line, Nelson (1973), Moerk (1975, 1976), Vorster (1975), Abrams, Chiarello, Gress, Green and Ellet (1976), Glanzer and Dodd (1975), and Newport, Gleitman, and Gleitman (1977) have reported correlations obtained for various measures of mother and child language.

The paper adds to this literature by reporting cross-sectional mother-child, child-child, and mother-mother correlations for various language measures computed on samples of

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conversational speech available following completion of a study in the linguistic environment of normal and Down's syndrome children (Rondal, 1977).

## METHOD

### *Subjects*

Twenty-one normal (13 boys, 8 girls) and 21 Down's syndrome children (trisomy 21; 9 boys, 12 girls) and their mothers served as subjects. All were Caucasian, monolingual (American English), and they came from middle-class backgrounds. The normal and Down's syndrome children were matched for mean length of utterance (henceforth, MLU, computed after Brown's criteria, 1973) on the basis of the total sample of speech recorded (i.e., one-hour mother-child interaction). Specified MLU range was 1.00-3.00 with a few instances minimally outside the prescribed range. The normal children ranged in chronological age (CA) from 20 to 32 months and the Down's syndrome children from 3 to 12 years. The difference in CA between the two groups was a consequence of their matching for MLU.

### *Procedure*

The verbal interaction between mother and child was tape recorded at home in a free-play situation. A verbatim transcription was made of the tapes. An utterance was defined according to Siegel as "a unit of spoken language marked off on either side by a pause or by some change in inflection" (Siegel, 1963, Appendix H, p. 101). Fifty-utterance samples randomly selected from the tapes were transcribed independently. The percent agreement between examiners for transcription and utterance segmentation was high (above 84%).

### *Analysis of the data*

Ten measures of child language and thirteen measures of mother language were computed on samples of speech varying in size between total sample and 400 related utterances (200 utterances for type-token ratio). They were: *type-token ratio* (henceforth, TTR, i.e., the ratio of the number of different words to the number of words sampled), *MLU*, *number of modifiers per utterance*, *total verbal output in number of words*, *proportion of declarative sentences* (utterances for the children), *proportion of imperative sentences*, *proportion of wh-questions*, *proportion of yes/no questions*, separately for mothers and children; *proportion of utterances without verb*, *proportion of utterances that were exact or partial repetitions of an immediately preceding maternal utterance*, for children only; *ratio of number of compound verbs plus subordinate clauses to total number of utterances*, *proportion of utterances that were expansions of children's utterances within three utterances from the original utterance*, *proportion of utterances that were exact or partial repetitions of children's utterances within three utterances from the original utterance*, *proportion of mothers' utterances that were exact repetitions of their own utterances within three utterances of the original utterance*, and *proportion of utterances explicitly*

TABLE I  
Children's correlations for ten speech measures

	TTR	MLU	WV	M	VO	R	D	I	WhQ	Y/NQ
TTR		0.62***	-0.53***	0.41**	0.44**	-0.48***	0.55***	0.22***	0.03	0.23
MLU			-0.86***	0.73***	0.81***	-0.69***	0.92***	0.41**	0.18	0.46***
WV				-0.70***	-0.79***	0.68***	-0.86***	-0.62***	-0.40**	-0.52***
M						-0.57***	0.78***	0.44**	0.12	0.32**
VO						-0.69***	0.79***	0.49***	0.30*	0.37**
R							-0.71***	-0.42**	-0.18	-0.34*
D								0.36**	0.06	0.38**
I									0.24	0.37**
WhQ										0.24
Y/NQ										

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$  (d.f. 40).

Note. TTR: type-token ratio; MLU: mean length of utterance; WV: proportion of utterances without verb; M: number of modifiers per utterance; VO: total verbal output; R: proportion of children's utterances that are repetitions of maternal utterances; D: proportion of declarative utterances; I: proportion of imperative sentences; WhQ: proportion of *wh*-questions; Y/NQ: proportion of *yes/no* questions.

*approving of childrens' utterances within three utterances of the original utterance, for mothers only.*

Counting reliability in terms of agreement between two independent raters varied between 84 and 98%.

## RESULTS AND DISCUSSION

Children's product-moment correlations, mothers' correlations, and mothers-children intercorrelations were computed on the whole sample of subjects ( $N = 42$ ). It was decided not to report separately on normal and Down's syndrome children for the following reasons. First, the speech of the normal and Down's syndrome children, as well as the speech of their mothers, appeared to be remarkably similar as far as the measures listed above were concerned. Rondal (1977) has reported extensively on those data and they will not be reproduced here. Second, the correlations and intercorrelations were fairly similar for normal and Down's syndrome children and their mothers. As to the first point, such a similarity does not come as a surprise in the case of the children since they were matched on the basis of MLU. This finding attests to the validity of MLU as an indicator of linguistic development in retarded as well as in normal children. It also has important implications for the question of knowing whether language development in mentally retarded children is simply delayed or whether it proceeds in a different way from that in normal children (e.g., Yoder and Miller, 1972). These implications have been discussed elsewhere (Rondal, 1977). Such a similarity in the speech of the mothers of normal and Down's syndrome children of different ages is somewhat more surprising. It supplies overwhelming evidence for the adaptability of maternal speech as argued elsewhere (Rondal, 1977).

### *Children's and Mothers' Correlations*

Table 1 presents the correlation matrix for children. As expected, MLU is negatively correlated with proportion of utterances without verb and positively correlated with number of modifiers per utterance. MLU is also negatively correlated with proportion of repetitions of maternal speech. This confirms a corresponding negative correlation (0.48,  $p < 0.01$ ) reported by Moerk (1975) for children between one year nine months and five years. Nelson (1973) has reported a corresponding negative trend (0.28, non significant) for 18 children aged 24 months and later for the same children at 30 months. These data confirm the observation that the frequency of children's repetitions of maternal speech decreases as a function of increased expressive capacity (Seitz and Stewart, 1975; McLean and Snyder, 1977). Also in the present data, proportion of repetitions of maternal speech is highly correlated with proportion of utterances without verb. On this basis, it would be of value to investigate whether many children's repetitions of maternal speech between MLU 1.00 and 3.00 tend to leave verbs out.

As a way of clarifying the data, the phenogram obtained from the correlation matrix through a sequential agglomerative hierarchical cluster analysis by minimum distance method (Sokal and Sneath, 1963) is provided in Fig. 1. This analysis illustrates the rela-

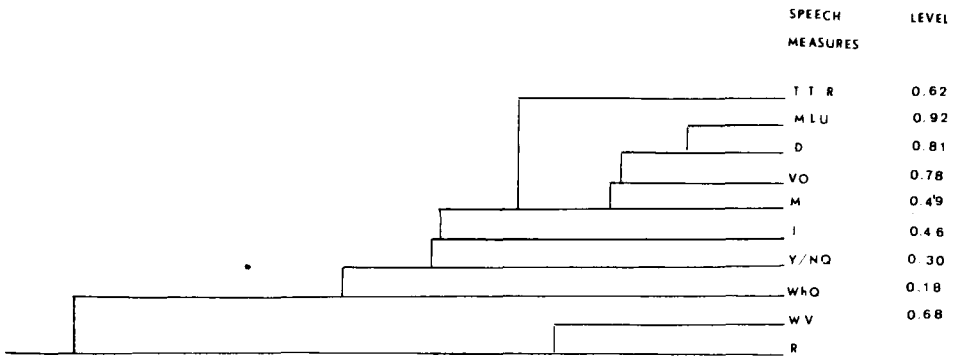


Fig. 1. Phenogram from children's correlation matrix. TTR: type-token ratio; MLU: Mean length of utterances; WV: proportion of utterances without verb; M: number of modifiers per utterance; VO: total verbal output; R: proportion of children's utterances that are repetitions of maternal utterances; D: proportion of declarative utterances; I: proportion of imperative sentences; WhQ: proportion of *wh*-questions; Y/NQ: proportion of *yes/no* questions. The numbers at the right of the phenogram give the similarity level at which each cluster joins the branch on the phenogram below. The phenogram is to be read as follows. The process begins with variable MLU. It joins with the cluster below consisting of variable D. The new cluster is shown in the table by the intersection of the lines. This cluster joins with the cluster below it consisting of variable VO therefore forming a new cluster. This new cluster joins with the cluster below it consisting of variable M, and then TTR, and I, and so forth. The process continues until each variable is joined at least to one other variable.

tionships as a group of variables between MLU, proportion of declarative utterances, verbal output, number of modifiers per utterance, and TTR.

The above findings suggest a verbal profile for children with higher MLU and conversely for children with lower MLU. The former use a lexicon that has some diversity. They are talkative, do not repeat much of mothers' utterances, and express themselves mostly through the use of declarative utterances and *yes/no* questions. They easily take leadership in the interaction with the mothers as indicated by the use of imperative sentences.

Table 2 presents the matrix for mothers' correlations. Expectedly, mothers' MLU correlates positively with ratio of number of compound verbs plus subordinate clauses to total number of utterances, number of modifiers per utterance, and negatively with proportion of imperative sentences and repetitions of children's utterances. MLU also correlates positively, although to a lesser degree, with talkativeness (i.e., verbal output) and negatively with proportion of maternal utterances that were repetitions of their own utterances. The latter may suggest the hypothesis that mothers tend to repeat those of their utterances that are shorter, presumably fulfilling then a directive function or trying

TABLE 2  
Mothers' correlations for 13 speech measures

	TTR	MLU	UC	M	VO	D	I	WhQ	Y/NQ	E	R	SR	A
TTR	0.22												
MLU	0.18	0.22											
UC	0.80***	0.80***	0.18										
M	0.73***	0.73***	0.27*	0.27*									
VO	0.48***	0.48***	0.27*	0.32*	0.27*								
D	0.01	0.01	0.08	0.01	0.08	0.01							
I	0.36**	0.36**	0.27*	0.48***	0.27*	0.48***	0.36**						
WhQ	0.33**	0.33**	0.08	0.33**	0.08	0.33**	0.08	0.28*					
Y/NQ	0.25	0.25	0.17	0.25	0.17	0.25	0.17	0.15	0.25				
E	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07			
R	0.45***	0.45***	0.33*	0.45***	0.33*	0.45***	0.33*	0.38**	0.45***	0.33*	0.38**		
SR	0.23	0.23	0.08	0.23	0.08	0.23	0.08	0.13	0.23	0.08	0.13	0.08	
A	0.09	0.09	0.08	0.09	0.08	0.09	0.08	0.04	0.09	0.08	0.04	0.08	0.09

Note. TTR: type-token ratio; MLU: mean length of utterance; UC: utterance-complexity ratio, i.e., ratio of the number of compound verbs plus subordinate clauses to total number of utterances; M: number of modifiers per utterance; VO: total verbal output; D: proportion of declarative sentences; I: proportion of imperative sentences; WhQ: proportion of *wh*-questions; Y/NQ: proportion of *yes/no* questions; E: proportion of maternal utterances that were expansions of children's utterances; R: proportion of maternal utterances that were repetitions of children's utterances; SR: proportion of mothers' utterances that were repetitions of their own utterances; A: proportion of maternal utterances explicitly approving of children's utterances.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$  (d.f. 40).

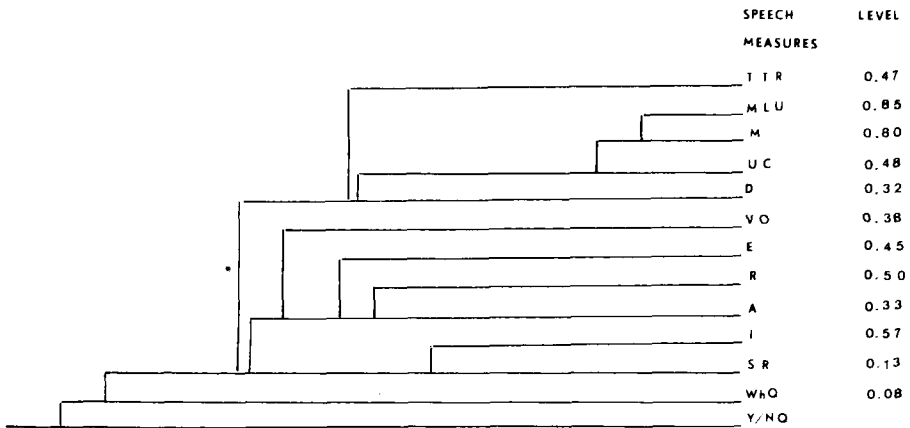


Fig. 2. Phenogram from mothers' correlation matrix. See the note to Table 2. The numbers at the right of the phenogram give the similarity level at which each cluster joins the branch on the phenogram below.

to draw or to retain the child's attention on a feature of the interactive context. In order to test such an hypothesis, an analysis of specific utterance sequences of individual mothers would have to be performed. The correlation between MLU and approval is null and not negative which indicates, if still necessary, that maternal approval is not simply to be confounded with minimal verbal reinforcement (Richelle, 1971; Rondal, 1978). There is no correlation between MLU and TTR which suggests that in mature speech as opposed to children's speech lexical diversity is independent of formal complexity. Declarative sentences but not *wh-* and *yes/no* questions correlate positively with all the indexes of formal complexity. This may indicate that formal complexity is avoided in questions at this stage, possibly on the ground that question forms are complex enough for the child to process without the addition of any lengthening or formally complexifying agent.

Proportion of expansions is positively correlated with verbal output and negatively correlated with ratio of number of compound verbs plus subordinate clauses to total number of utterances, and with TTR. The latter finding may be taken to suggest that mothers tend not to vary lexical items excessively when expanding children's utterances. In other words, expansions may be used by mothers preferably to introduce common items (among which most are functors) in children's utterances. This is indeed what expansion is all about (Brown and Bellugi, 1964).

Fig. 2 presents the phenogram obtained from the correlation matrix through cluster analysis. The profile of the mothers who produce relatively high MLU speech appears to be the following (and conversely for mothers with relatively low MLU speech). The lexicon used is relatively homogeneous. They are reasonably talkative and use declarative sentences. They do not repeat much of the child's or of their own utterances. Accent is on sentence complexity and use of modifiers.

TABLE 3  
 Mothers-children intercorrelations for ten measures of children's speech  
 and 13 measures of mothers' speech

	Children												
	TTR	MLU	WV	M	VO	RI	D	I	WhQ	Y/NQ			
TTR	0.23	0.47***	-0.49***	0.53	0.37**	-0.47***	0.51***	0.36**	0.25	0.05			
MLU	0.49***	0.55***	-0.41**	0.51***	0.36**	-0.38**	0.54***	-0.02	-0.18	0.17			
UC	0.48***	0.50***	-0.40**	0.35**	0.33*	-0.42**	0.50***	0.03	-0.15	0.31			
M	0.35**	0.46***	-0.41**	0.57***	0.29*	-0.25	0.50***	0.03	-0.16	0.20			
VO	0.29*	-0.04	0.18	-0.12	-0.02	0.23	-0.11	-0.32*	-0.16	0.07			
D	0.23	0.51***	-0.51***	0.65***	0.28*	-0.27*	0.50***	0.27*	0.15	0.26*			
I	-0.48***	-0.63***	0.37**	-0.30*	-0.44**	0.40**	-0.50***	-0.04	0.04	-0.13			
WhQ	0.18	0.04	0.04	-0.30*	-0.01	0.10	-0.12	-0.15	0.09	0.05			
Y/NQ	-0.30*	-0.21	0.35**	-0.19	-0.07	0.12	-0.10	-0.22	-0.47***	-0.28*			
E	-0.33**	-0.61***	0.63***	-0.39**	-0.69***	0.75***	-0.62***	-0.45**	-0.23	-0.29*			
R2	-0.01	-0.31*	0.43**	-0.26*	-0.38**	0.49***	-0.35**	-0.27	-0.15	-0.16			
SR	0.55***	-0.70***	0.51***	-0.62***	-0.61***	0.57***	-0.70***	-0.15	0.04	-0.08			
A	0.23	-0.13	0.30*	0.01	-0.41**	0.29*	-0.19	-0.27*	-0.14	0.04			

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.000$  (d.f. 40).

Note. See the note to Table 2. R1: proportion of children's utterances that were repetitions of maternal utterances; R2: proportion of maternal utterances that were repetitions of children's utterances.



*Mothers-Children intercorrelations*

Table 3 presents the matrix for mothers-children intercorrelations. As this matrix is not rectangular, no cluster analysis of the above type could be performed.

Children's proportions of imperative, *wh*-questions, and *yes/no* questions are not correlated to maternal speech indexes except for a positive correlation between children's proportions of imperatives and maternal expansions, and for a negative correlation between children's use of *wh*-questions and maternal use of *yes/no* questions. The latter finding is intriguing in view of the absence of correlation between maternal and children's use of *wh*-questions. In the same way, mothers' proportions of *wh*-questions and *yes/no* questions show almost no correlation with children's speech indexes. Similar lack of correlation between maternal questions and children's MLU at 24 months was reported by Nelson (1973) for 18 mother-child pairs. Mothers' proportion of imperatives shows negative correlations with children's TTR, MLU, number of modifiers per utterance, verbal output, and proportion of declarative utterances. The same maternal index is positively correlated with children's proportion of repetitions of maternal utterances. As expected, children's TTR is positively associated with maternal MLU, sentence complexity, number of modifiers per utterance, verbal output, and negatively associated with maternal proportion of imperative sentences, *yes/no* questions, proportion of expansions, and proportion of mothers' repetitions of their own utterances. Conversely, mothers' MLU is positively associated with children's MLU and with the other indexes that are related to formal complexity of speech. Moerk (1975) also reported a positive correlation ( $0.61, p < 0.01$ ) for a sample of mother-child pairs with the children aged between one year nine months and five years. Similarly, Nelson (1973) reported a positive correlation ( $0.47, p < 0.05$ ) between mothers' MLU (for child-directed utterances) and children's MLU at 24 months. However, Vorster (1975) failed to obtain a rank correlation between mothers' and children's MLU but he used a sample of only three mother-child pairs with the children aged between 24 and 44 months. Yet, the correlation ratio ( $r_s = +0.45$ ) was in the expected direction and a related correlation between mothers' and children's MLU for the five longest utterances was close to significance ( $r_s = +0.55$ ). Continuing with the present data, mothers' MLU is also positively correlated with children's proportion of utterances without verb and repetitions of maternal utterances. Many of the same patterns are observed in the intercorrelations between the other maternal and children's indexes related to speech complexity, suggesting a close relationship between formal complexity in maternal and in children's speech.

Mothers' proportions of expansions, repetitions of children's utterances, and repetitions of their own utterances are mostly negatively correlated with those indexes of children's speech that reflect formal complexity of discourse. Similarly, Newport, Gleitman, and Gleitman (1977) have found mothers' self-repetitions negatively associated with the child's age ( $r = -0.55, p < 0.05$ ) and with several measures of linguistic sophistication like mean verbs per utterance ( $r = -0.68, p < 0.01$ ) and vocabulary development ( $r = -0.69, p < 0.01$ ). Their study used 15 mothers and their young daughters aged 12 to 27 months. Also Moerk (1975) has reported a negative correlation ( $0.61, p < 0.01$ ) between children's MLU and mothers' corrective feedbacks for a sample of mothers and their children aged

between one year nine months and five years. This reflects a decline in maternal expansions, repetitions, and corrections with increasing language skills in the children (McLean and Snyder, 1977). Moerk's 1976 report shows that the frequencies of maternal instructions (including modeling) decrease markedly between one year nine months and five years for all language aspects (phonological, morphological, lexical, and syntactical) despite some individual variations between mothers. Mothers' proportions of expansions, repetitions of children's utterances, and repetitions of their own utterances are positively related to children's proportion of utterances without verb and to children's repetitions of maternal utterances (the latter two being positively correlated as shown in Table 1). This may suggest that there is a reciprocal style in mother-child verbal interaction: expansive and repetitive maternal behaviours tend to be associated with repetitiousness in children's behaviours. Indeed, Moerk (1976) has shown that there are high transitional probabilities between the elements of the following chain in mother-child dyads between one year nine months and five years: child encodes (answers mother's question) – mother expands (corrects) child's production – child imitates mother's expansion (correction) – mother acknowledges (reinforces) child's compliant production.

Finally, mothers' proportion of approvals of children's utterances is negatively correlated with children's verbal output. This is no surprise as children's talkativeness increases with MLU level (Rondal, 1977) whereas mothers' proportion of explicit approvals of children's utterances tends to decrease with increase in children's MLU. Mothers' proportion of approvals of children's utterances is positively correlated with children's proportion of utterances without verb and with children's repetitions of maternal utterances. This is predicted by Moerk's chain and the correlations reported above between those two children's indexes.

In summary, the present findings confirm and add to previous reports. Several formal variations in mothers' speech appear to be highly related to linguistic development in the children and deserve further investigation. The mother-mother and the child-child correlations should be of considerable interest to the student of child's and mothers's language when having to decide which speech measures to select for a study. In this context, the concurrent and predictive validity of MLU as a reflection of formal complexity in child's and mother's speech (directed to the child) for normal as well as for Down's syndrome children was confirmed. Along the same line, the verbal profiles suggested for children and mothers with high and low MLU values should be further investigated as an approach toward analysing the lengthening process in child's and child-directed mother's speech with time (see Vorster, 1975, on this point).

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