J. Child Lang. **6**, 423–442. Printed in Great Britain

Mothers' speech to children and syntactic development: some simple relationships*

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(*Received* 20 *August* 1978)

ABSTRACT

This study investigated the relationships between children's linguistic environments and their language acquisition. Speech samples taken from seven firstborn children and their mothers when the children were 1 ; 6 and 2 ; 3 were analysed within a number of semantic and syntactic categories to determine correlations between mothers' speech and subsequent language development. Several characteristics of mothers' speech (e.g. utterance length, use of pronouns) significantly predicted later child speech. The significant correlations suggested that mothers' choice of simple constructions facilitated language growth. Further, they showed that the motherese code differed from adult–adult speech in ways which aided language development. Differences between our study and previous investigations of environmental effects on language development probably resulted from the failure of earlier investigations to take into account children's level of language competence at the time when environmental effects were assessed.

INTRODUCTION

Whether or not the environment plays a significant role in language development has been a controversial issue for some time. The consensus of psycholinguists has run consistently against environmental importance. Ever since Chomsky's (1965) assertion that knowledge of the grammar of language must be innate, it has been the responsibility of those who held otherwise to show cause for rejecting this view. There have been two main lines of research investigating the issue, neither of which has been conclusive. One has tried to show that manipulation of the linguistic environment can have effects on language acquisition. For example, the effects of supplying expansions of child utterances or recast sentences

[*] The first author was supported by a Canada Council pre-doctoral fellowship; the research was partially supported by a grant from the Carnegie Corporation of New York. We would like to thank Melissa Furrow for aid in the syntactic analysis. Katherine Nelson is now at the City University of New York Graduate Center. Address for correspondence: David Furrow, Department of Psychology, Yale University, 2 Hillhouse Avenue, New Haven, Connecticut 06520.

0305-0009/79/0631-0003 $01.50

on specific language growth measures has been studied. Originally, no effect of the manipulation was reported (Cazden 1965, Feldman 1971), but more recent studies (K. E. Nelson, Carskaddon & Bonvillian 1973, K. E. Nelson 1977*b*) have reported predicted effects on the acquisition of specific forms. A second line of research, and the one with which we are concerned here, has looked at naturally occurring linguistic variations in the environment which might have effects on language acquisition. Speculation has focused on the now well documented distinctiveness of mothers' speech to children as compared to speech between adults (see reviews by Snow 1974, Vorster 1975, Newport 1977) and its possible facilitating effects.

The existence of a special mother-to-child code (MOTHERESE) which appears simpler than adult–adult speech has sometimes been considered evidence in itself for the influence of environmental variation on children's language acquisition (e.g. Vorster 1975). Such a conclusion is understandable historically, since these data counter the observations on which Chomsky's (1965) nativistic supposition was based – that the speech heard by children was disorganized, ungrammatical and confusing. Nevertheless, while the motherese evidence is suggestive, it does not demonstrate environmental effects on language acquisition. A more convincing demonstration would involve significant correlations between aspects of motherese and aspects of child language development; that is, it would locate variations among mother's speech (as representations of the variations which occur among children's total linguistic environments) which could predict the variations in acquisition rate of specific language forms among their children. Nelson (1973) used this design and found significant correlations but, since her concerns lay elsewhere, she looked primarily at measures of functional or content characteristics of motherese, as opposed to the syntactic characteristics which have been the focus of the nativist-environmentalist debate.

In the most relevant study to date, Newport, Gleitman & Gleitman (1977) attempted a detailed analysis of the relationship between mother's speech and children's language growth. They tape-recorded 'natural' speech in fifteen mother–daughter dyads during two one-hour sessions held six months apart. Initially, the children fell into three age groups; 1 ; 0–1 ; 3, 1 ; 6–1 ; 9 and 2 ; 0–2 ; 3. Correlations between syntactic and stylistic aspects of mothers' speech in the first session and measures of child language development between sessions were examined. Child language development was measured by changes over the six month period in constructions classified as 'language specific' or 'language general'. These categories purportedly distinguish between those surface morphological and syntactic elements which have varying forms in different languages (e.g. auxiliaries, noun inflections) and forms common to all languages (e.g. verbs, noun phrases). They were further seen as a distinction between 'cognitive semantic' relations (language general) and grammatical functions which

elaborate these relations (language specific).[1] Age and initial language competence of children were partialled out in a statistical manipulation designed to determine effects of mothers' speech independent of the age or abilities of their children. Newport *et al.* concluded that a limited number of effects existed, 'on the acquisition of language-specific aspects of surface structure' while 'the acquisition of universal aspects of language design proceeds in indifference to the details of varying individual environments' (Newport *et al.* 1977: 145). They explained their significant correlations by postulating two ways in which mothers facilitated learning of specific constructions by their children: (1) Mothers who often used constructions with a given structure (e.g. auxiliaries) in frontal position in effect high lighted these constructions because of children's bias toward processing constructions in initial positions. (2) Mothers ensured that they and their children had matching referents by using constructions which left little doubt as to the identification of the referent.

Unfortunately, Newport *et al.*'s data did not unequivocally support their conclusions. Implicit in the statistical treatment of their data were the assumptions that (*a*) effects of motherese were similar at all ages and levels of language development over the one to two year age range used; and (*b*) that changes in the use of particular forms were equally likely regardless of a child's age or stage. There are many reasons to believe that mothers' speech will have different effects at different ages or stages. For example, characteristics of motherese change over time (Phillips 1973); correlations with children's speech characteristics are different at different ages (Nelson 1973, Seitz & Stewart 1975); children's comprehension of adult speech changes radically over the age range in question (Benedict 1976). In addition, descriptive accounts of child language development (e.g. Brown 1973) make it clear that changes are not equally likely at different ages or stages. For all these reasons, the question of whether or not there are environmental effects on children's acquisition of grammatical constructions remains equivocal.[2]

The present study was carried out to assess effects of motherese on child language acquisition while avoiding the unwarranted assumptions of prior

[1] It is arguable whether or not this is a valid distinction. However, it was of basic importance to Newport *et al.*, and our results bear on their findings concerning it.

[2] Cross (1978), in a study which at the time of writing we were unable to obtain but which is summarized in Snow & Ferguson (1977), has also attempted 'to test the prediction that degree of speech modification in a child's linguistic environment is associated with the process of syntactic development'. She matched pairs of children for MLU and formed two groups called 'normally developing' and 'accelerated' by putting the older of a dyad into the former category and the younger into the latter. Mothers' speech was then compared between groups. The only significant differences found were that mothers' use of utterances semantically similar to the child's preceding utterances was greater in the 'accelerated' group. However, because MLUs ranged widely within each group, the criticisms made of Newport *et al.* above are also applicable to this study.

studies. In this design, correlations between motherese and the language development of same-aged children who were all at the one-word stage at the time of the first sample were determined. Matching age and stage ensured that differences on these dimensions that might affect differences in children's capacity to learn grammatical constructions were controlled. Further, by equating these aspects of development, any systematic influences that such differences might have had on mothers' speech to children were minimized, leaving individual differences among mothers to account for most of the variation that was observed.

METHOD

Subjects

Seven mothers and their first born children (4 male, 3 female) from middle class white English speaking families participated in the study from which our data were obtained. Mothers were primary caretakers and did not work outside the home more than 10 hours per week. In all cases, both parents lived in the home and both had a minimum of a high school education. At 1;6, the time of the first language sample, 6 of the 7 children had mean length of utterances (MLUs) equal to one; the seventh child, while occasionally using longer utterances, was still in Brown's (1973) Early Stage I with an MLU estimated at less than 1·4. Thus there were no significant differences on productive child language measures, or stage of language development.[3] Further information about subjects and selection is available in Benedict (1976).

Procedure

The speech samples analysed for this report were obtained from the mother-child pairs when the children were 1;6 and 2;3. One-hour speech samples were collected in home settings by an experimenter (H. Benedict) who had been working with the dyads since before the children were 0;10, first at biweekly intervals and later in the second year every month. Home visits were timed to correspond with the child's most alert and rested period of the day. One hundred utterances by mothers at both times and 100 utterances by children at 2;3 were analysed within a number of semantic and syntactic categories (see analysis section).Children's speech samples at 1;6 were considered only in terms of MLUs because of the immaturity of their speech at that time. All speech samples were analysed by a naive experimenter (D. Furrow) who was uninformed about the relative development of individual children. Brown's (1973: 54) rules were followed in the selection of utterances used in these analyses. The only exception was

[3] There were differences among the children in receptive language abilities, however. This factor is discussed separately below.

that both mother and child utterances spoken when a mother was reading to her child were omitted. This was done to make situations across mothers more comparable; Broen (1972) and Snow (1974) both have shown that reading changes mothers' speech in systematic ways (for example, MLU increases). For one child, the requisite 100 utterances at 2;3 were not obtained – category scores for this child were prorated in all analyses.

Effects of mothers' speech on child language growth and concurrent relationships between mothers' speech and child language were assessed by calculating Pearson product–moment correlation coefficients between measures of mothers' speech in both 1;6 and 2;3 samples and measures of children's speech at 2;3. There are a number of issues concerning the interpretation of these correlations to be considered. First, according to the logic of Campbell & Stanley (1963), to assert that mother's speech at time t_1 is responsible for differences among children's speech at time t_2 on the basis of a significant correlation between them, it is necessary to ensure that the significance did not result from (*a*) differences in the children at t_1 accounting for the variation among mothers at t_1 while also being responsible for the variations amongst themselves at t_2 (thus producing an artificial 'mothers at t_1–children at t_2' correlation); or (*b*) differences in mothers at t_1 accounting for differences in mothers at t_2 which were in turn responsible for the concurrent differences between children at t_2. As our design makes it possible to assume that significant language differences did not exist between children at t_1 (i.e. at 1;6), it was unnecessary to consider the relationships involved in alternative explanation (*a*) above. On the other hand, alternative explanation (*b*) is only plausible when a significant correlation exists between mothers' speech at t_2 and child speech at t_2 which is of the same sign as the significant correlation between mothers' speech at t_1 and child speech at t_2. As we shall see this was never the case. Therefore, we were confident that any 'mother at 1;6/child at 2;3' correlations were actually representative of the relationship between motherese at the earlier time and later speech, subject of course to the usual limitations of correlations.

The nature of correlations is such that unexplored confounding third variables must always be assumed to exist, so that a significant correlation between an aspect of mothers' speech and an aspect of child language acquisition does not necessarily mean that the two are related in cause and effect fashion. In as much as we can rule out artifactual mother–child effects as discussed above, it is possible to infer that there is a true effect of mother speech at t_1 on child speech at t_2. Nonetheless, one cannot be certain what causal relationship underlies a correlation. We will suggest here explanations for the correlations that we report, some of which will seem obvious and others less so, but such explanations must in all cases be considered provisionary. As in all such research, experimental manipulations will be necessary to clarify the precise nature of the relationship between mother and child speech.

Analysis

Mothers' speech. The analysis of mothers' speech included a number of measures of semantic and syntactic aspects, most of which have been used in previous studies. Some of the categories occurred with such small frequencies that meaningful interpretation of them was impossible; these were excluded from further consideration. The remaining categories in which mothers' speech was analysed are as follows:

Sentence Types. Utterances were classified according to sentence type. Unlike previous analyses, ALL utterances which were included in the study were classified into the following categories:

(1) declaratives;
(2) imperatives;
(3) *wh*-questions;
(4) *yes/no* inversions (see Broen 1972);
(5) other *yes/no* questions – this category included *yes/no* questions which had deleted portions (e.g. *want to go to the store*?) and intonation only questions (*It's mine*?). Often, the two types were indistinguishable (*give him a ride*?).
(6) tag questions – these low-frequency utterances were counted separately but were only considered as a third type of *yes/no* question when the sum of *yes/no* questions was considered.
(7) interjections and fragments – basically, these were incomplete utterances, e.g. *the big red ball*!, *in the closet*!, *yes*!. Vocatives were counted in this category. Fragments of utterances were not always counted as interjections; for example, *and she is gone* would have been considered a declarative while fragments uttered with question intonation (e.g. *no balls*?) were counted as *yes/no*-others and not as interjections.

All utterances were classified into one and only one of the above sentence types.

Structural Units. Utterances were further broken down into the following categories (mean frequencies were determined unless otherwise specified):

(1) words;
(2) sentence nodes – number of propositions were counted. Chomsky's (1965) grammar was used to determine sentence nodes, except that prenominal adjectives were not counted as adding propositions (Newport 1977, also followed this rule).
(3) nominals:
    (*a*) nouns,
    (*b*) pronouns;
(4) verbs:
    (*a*) main verbs,

(*b*) auxiliaries (modal auxiliaries were included here, not as main verbs),
(*c*) copulas;

(5) modifiers:
(*a*) noun modifiers – adjectives which modified an expressed noun or adjective were included. Adjectival prepositional phrases were counted as one unit.
(*b*) verb modifiers – adverbs which modified an expressed verb or adverb were counted here. Adverbial prepositional phrases were also included; regardless of length, each phrase was counted as being a single modifier.

The remaining measures are representative of Brown's category of grammatical morphemes acquired by the children in his sample after Stage I.

(6) tense – the mean number of utterances which used any tense other than the present were counted. *Is going to* used as a future construction was included.
(7) plurals – number of plural nouns and pronouns were counted.
(8) genitives – forms indicating possession (*my*, *daddy's*, *your*).
(9) negatives – use of components (*no*, *not*, *n't*) expressing nonexistence or negation of objects or acts was counted.
(10) contractions – these included contracted copulas, auxiliaries, and negatives.
(11) prepositions – all prepositions were scored, regardless of whether an object was expressed or not.

Table 1 gives the mean frequency scores for the above measures of mothers' speech at both child ages. It is important to note that our findings are consistent with those of prior studies. An MLU of about 4 for mothers addressing their 2-year-old children has been found by Nelson (1973), Newport (1977), Phillips (1973), and Snow, Arlman-Rupp, Hassing, Jobse & Vorster (1976), among others. Our findings of 1·15–1·16 sentence nodes per utterance agrees with Newport's (1977) figure of 1·16. Phillips (1973) reported figures of 0·82 and 0·92 for number of verbs/utterance to children of 0; 8 and 2; 4 respectively. We found figures of 0·87 and 0·84 for our groups of children at 1; 6 and 2; 3. Phillips found 0·73 (0; 8-year-olds) to 0·83 (2; 4-year-olds) modifiers per utterance. Although our criteria for judging differed somewhat, our comparable figures are 0·67 and 0·73 (noun plus verb modifiers). On the other hand, our sentence type analysis appears to yield discrepant results when compared to Newport's (1977) analysis. For example, her proportion of declaratives, 0·38 (we are considering Newport's deictic 'statements' as declaratives), is much greater than our 0·22–0·25. Such differences can be understood as differences in criteria – we included an interjection category which counted stock expressions, sentence fragments, etc., while these were not considered in Newport's classification scheme.

These congruencies of our motherese characteristics with those found in past studies help to validate the analysis of our small sample size. Conclusions found regarding effects of mothers' speech may thus, to some extent, be justifiably generalized.

It is worth noting that there were few changes in overall characteristics of speech over the nine month period, with the one exception of the substantial drop in noun use and the less striking rise in pronoun use. This is consonant with studies reporting a similar shift for many children over the same period (Bloom, Lightbown & Hood 1976, Nelson 1975).

TABLE 1. *Mothers' use of certain language constructions when their children were at* 1 ; 6 *and* 2 ; 3 (*mean frequencies per* 100 *utterances*)

	Age of Child	
	1 ; 6	2 ; 3
Declaratives	22·3	25·0
Imperatives	21·1	19·0
Wh–questions	18·6	14·6
Yes/no inversions	7·6	8·1
Yes/no questions (other)	9·3	7·6
Interjections, fragments	20·6	24·8
Words	402·9	393·6
Sentence nodes	114·8	116·1
Nouns	72·9	52·3
Pronouns	69·9	75·9
Verbs	86·9	83·6
Auxiliaries	27·1	27·9
Copulas	20·8	19·0
Noun modifiers	22·6	22·2
Verb modifiers	44·3	50·6
Tense	7·9	10·1
Plurals	9·0	12·7
Genitives	7·6	7·0
Negatives	9·8	11·9
Contractions	30·5	24·6
Prepositions	15·0	15·9

Children's speech. At 2 ; 3, measures of children's speech were a subset of all those used by Newport *et al.* (1977), namely, the measures for which they reported data (see their Table 3) as follows:

(1) mean length of utterance – mean number of words per utterance;[4]
(2) verbs per utterance;
(3) noun phrases per utterance;
(4) auxiliaries per verb phrase;

[4] Newport *et al.* used morphemes, but the words per utterance measure was chosen for simplicity; it is highly correlated with morphemes/utterance.

(5) inflections per noun phrase – the total number of regular plurals used by children were counted, except that inflections occurring in identical utterances were included only the first time they appeared. No other noun inflections were observed.

According to Newport *et al.*'s distinction, the second and third categories measured language general constructions, while the last two categories measured language specific constructions. MLU reflected aspects of both. The results of this analysis are shown in Table 2. MLUs at this point (2 ; 3) ranged from 1·09 to 3·31, showing that the linguistic abilities of our subjects ranged from Brown's Early Stage I to Stage IV. In addition to MLU, verb and noun phrases per utterance were high frequency measures with a wide range of variation. Unfortunately, neither of the language specific measures was based on frequent events. Auxiliaries per verb phrase were founded on a mean of approximately 4 auxiliaries per child, while inflections per noun phrase were based on a mean of approximately 3 inflections per child.

TABLE 2. *Mean, standard deviation and range of the five measures of children's speech at* 2 ; 3

	Mean	Standard deviation	Range
Mean length of utterance	1·95	0·86	1·09–3·31
Verbs per utterance	0·32	0·22	0–0·57
Noun phrases per utterance	0·87	0·29	0·49–1·24
Auxiliaries per verb phrase	0·08	0·13	0–0·37
Inflections per noun phrase	0·04	0·03	0–0·08

Such small frequency measures are disquieting for two reasons. First, small differences in count totals of the constructions involved could drastically affect correlations, inflating the role of error. Second, given such rare occurrences of the constructions, it becomes less clear that one is dealing with learning of the underlying grammatical rules rather than performance based on other factors. Brown (1973) used as a competence measure a 90% criterion for correct use of given morphemes in obligatory contexts. By this criterion acquisition of both plurals and auxiliaries occurred at average ages later than 2 ; 3. Plural inflections were found at 2 ; 1 for one child, and 2 ; 8 and 2 ; 9 for the two others in his study when MLUs averaged about 2·8. Auxiliaries came in much later; none of his subjects had learned these to criterion at the end of his study, at ages greater than 3 ; 6 for two of his subjects and MLUs (morphemes) over 4. We therefore examined the data from our subjects and determined that at least two had correctly learned auxiliary structure and that those accounted for most of the variance on this measure. That is, the distribution of subject scores was bimodal

with those not having learned auxiliaries not using them. We were less confident that the inflections/noun phrase range obtained accurately reflected our subjects' knowledge of the grammatical rule for plural inflections. The magnitude of and the variation among scores were not as great as for auxiliaries. We found no satisfactory way around these concerns, so the measure was dropped from further analyses.

Table 3 shows intercorrelations among the remaining child variables. Noun phrases per utterance, verbs per utterance, and MLU were highly related, while auxiliaries per verb phrase was less strongly related to the others. Given that these variables divided themselves into groups, further discussion will treat them dichotomously.

TABLE 3. *Intercorrelations among child variables at* 2 ; 3

	MLU	Verbs/ utterance	Noun phrases/ utterance	Auxiliaries/ verb phrase
MLU	1·00	0·94	0·94	0·74
Verbs/utterance		1·00	0·84	0·60
Noun phrases/utterance			1·00	0·62
Auxiliaries/verb phrase				1·00

RESULTS

A number of significant relations between mothers' speech and child language acquisition were found. Tables 4 and 5 show the computed correlations between child speech at 2 ; 3 and mothers' speech at 1 ; 6 and 2 ; 3 respectively, for the measures on which at least one significant correlation existed for either of the two ages.[5] We have also included all measures which this experiment had in common with Newport *et al.* (1977), whether or not significance was found, to allow for comparisons with their data. More significant correlations were found from 1 ; 6 (20) than at 2 ; 3 (11).

Mothers' speech to their children at 1 ; 6 contained significant predictors of all four measures of child language development, with the greatest number for MLU and number of verbs per utterance (see Table 4). Whatever the value of Newport *et al*'s (1977) language specific–language general distinction, it has none as a discriminating feature of those aspects of language which can or

[5] Scatterplots were used to verify that significant correlations were indicative of trends in the data, and not the result of one or two discrepant data points.

Statistical tests were one-tailed, since the direction of most correlations involving mother's speech at 1 ; 6 could be predicted (see discussion). In the rare case where no direction was predicted and significant correlations were found (e.g. copulas), the correlations were high enough to be significant at the two-tailed level. At 2 ; 3, where the direction of correlations was not predicted, most significant correlations reached the two-tailed level of significance.

cannot be affected by linguistic input. For the group of the presumably more basic measures of child language development – MLU, noun phrases and verbs per utterance – there were many significant predictors of language advancement, including a large number of negative correlations. The greater the number of words, verbs, pronouns, contractions or copulas per utterance used by a mother, the less advancement her child was likely to show over the time period observed. On the other hand, *yes/no* questions, especially those which were not simple inversions, and relatively greater use of nouns than pronouns were associated with greater language achievement by the child.

TABLE 4. *Correlations between maternal speech at* 1 ; 6 *and child speech at* 2 ; 3

	Child speech characteristics			
	MLU	Verbs/ utterance	Noun phrase/ utterance	Auxiliaries/ verb phrase
Declaratives	−0·25	−0·28	−0·22	−0·03
Imperatives	0·06	0·02	0·34	−0·47
Wh–questions	−0·37	−0·33	−0·48	−0·30
Total *yes/no* questions	0·72*	0·64	0·58	0·85**
yes/no inversions	0·14	0·08	−0·01	0·48
other *yes/no*	0·77**	0·74*	0·69*	0·72*
Interjections	0·57	0·67*	0·43	0·64
Words	−0·69*	−0·70*	−0·68*	−0·38
Sentence nodes	−0·53	−0·60	−0·46	−0·55
Pronouns	−0·75*	−0·81**	−0·62	−0·58
Noun/pronoun ratio	0·72*	0·74*	0·55	0·60
Verbs	−0·71*	−0·78**	−0·55	−0·66
Copulas	−0·85**	−0·90**	−0·77**	−0·58
Tense	−0·46	−0·47	−0·63	−0·09
Contractions	−0·65	−0·58	−0·84**	−0·21

* $P < 0{\cdot}05$.
** $P < 0{\cdot}025$ (all tests are one-tailed).

Our significant predictors of child language growth were generally quite different from those of Newport *et al.* (1977), being both greater in number and more widely distributed over the child measures. There were similarities, however, especially for predictors of auxiliaries per verb phrase. Looking only at mothers' use of sentence types (for reasons which will become clear in the discussion), of five correlations common to both studies (declaratives, *yes/no* questions, imperatives, interjections, and *wh*-questions) the direction and general magnitude of correlations were similar in all cases and in two cases the significance of correlations was agreed upon.

Table 5 shows that at 2 ; 3 all significant correlations between mothers' and their children's speech were with the three basic measures of child language development: MLU, verbs per utterance and noun phrases per utterance. No significant relationships with auxiliaries per verb phrase were found. Mothers'

use of imperatives and verbs were highly related in a positive direction to all three general measures of child language, while use of non-present tense was significantly correlated with children's MLU and use of verbs. Use of interjections was negatively correlated with language level. These correlations are quite different from those found by Newport (1977), in the correlation of mothers' speech and concurrent child speech for her group of subjects between 1 ; 0 and 2 ; 0. Such discrepancies support our assumption that the relation of mother and child language must take into account the child's stage of development.

TABLE 5. *Correlations between maternal speech and child language at* 2; 3

	Child speech characteristics			
	MLU	Verbs/ utterance	Noun phrase/ utterance	Auxiliaries/ verb phrase
Declaratives	0·15	0·27	0·06	0·08
Imperatives	0·88**	0·91**	0·76**	0·40
Wh–questions	−0·13	−0·20	−0·03	−0·31
Total *yes/no* questions	0·17	−0·07	0·25	0·50
yes/no inversions	−0·29	−0·54	−0·17	0·22
other *yes/no*	0·47	0·32	0·44	0·65
Interjections	−0·94**	−0·83**	−0·91**	−0·63
Words	0·53	0·51	0·62	−0·13
Sentence nodes	0·56	0·60	0·66	0·01
Pronouns	0·34	0·32	0·62	−0·14
Noun/pronoun ratio	−0·30	−0·36	−0·17	−0·53
Verbs	0·83**	0·78**	0·86**	0·33
Copulas	0·39	0·18	0·55	−0·02
Tense	0·67*	0·74*	0·46	0·43
Contractions	0·46	0·51	0·34	0·43

* $P < 0{\cdot}05$.
** $P < 0{\cdot}025$ (all tests are one-tailed).

A comparison of the data in Tables 4 and 5 supports our earlier assertion that no correlations existed at 2; 3 which could explain the significant correlations at 1; 6. The later correlations did not replicate those at 1; 6. Indeed, in many cases they were in the opposite direction, the most obvious case being mothers' use of verbs, which at 1; 6 was a significant negative predictor of child language growth, whereas at 2; 3 was positively related to current language level.

Data on comprehension. In our considerations so far, we have made the usual assumption that language development is reflected in the appearance of productive forms. It was on this basis that we claimed that all of the children were at the same stage of development at 1; 6. The data base for this study, however, formed part of a larger longitudinal study of the development of comprehension in early language (Benedict 1976). We were therefore fortunate in having available rank orders of comprehension abilities for the children between 1; 5 and 1; 7, as measured in terms of their understanding of a given number of

terms in spoken commands (see Benedict 1976 for further details of her stages). At 1; 5, all but two of the children were at the same stage of receptive language development. However, when all of the information available from 1; 5 to 1; 7 (including rate of development over this span) is used to derive a rank order of children the correlation with productive developmental status at 2; 3 is significant ($\rho = 0{\cdot}714$, $P = 0{\cdot}05$) as is the correlation with mothers' MLU at 1; 6 ($\rho = 0{\cdot}714$, $P = 0{\cdot}05$). Unfortunately, the robustness of these correlations is questionable given that most of the variation among children was due to differences at the extremities. Nonetheless, it is intuitively plausible that comprehension status at 1; 6 predicts production status at 2; 3 and that it is also associated with characteristics of mothers' speech at 1; 6.

DISCUSSION

The implication of our study for the role of the linguistic environment in language development is clear; it must be considered a significant contributor to all aspects of the language learning process. Effects of mothers' speech on child language acquisition have been found despite a small sample size and the fact that mothers' speech alone does not constitute the total linguistic environment of a child. This may reflect the strength of the actual relationships underlying the correlations found, although aspects of the research design maximized the probability of finding significant relationships, if any existed. First, that mothers' speech was a good sample of the children's total linguistic environment was to a large degree ensured by sampling dyads in which mothers were primary caretakers and their infants were first borns with no siblings. Second, that the mother–child interactions sampled were veridical samples of mothers' speech to their children was ensured by having a familiar experimenter meet with the dyads in their homes. These considerations and, more importantly, the methodological issues mentioned in the introduction are most probably responsible for differences between our positive findings and those of previous researchers who have looked more or less in vain for effects of mothers' speech on child language acquisition.

Interpretation of correlations. Beyond whether or not environmental effects exist is the question of what the effects are.[6] Specifically, what causal connections exist between individual environmental variables and the language growth which they predict? At a more general level, what distinguishes aspects of linguistic input which facilitate language growth from those which do not? Before discussing these issues, we would stress that because children's age and language abilities are important determinants of what the effects of the environment on

[6] We will discuss only interpretations of correlations between mothers' speech at 1; 6 and children's 2; 3 speech, and not concurrent mother–child language correlations. Our statistical analysis allows us to assume causal connections between the earlier mother speech sample and the later child one, but not for the concurrent correlations.

language development will be, our correlations and interpretations of them concern environmental effects at 1;6 only. Further, we must caution that interpretation of correlations is always speculative. However, our data do suggest certain relationships which are interesting and important.

Our insights as to specific causal connections are borrowed and few. Our data on the development of auxiliary structure were remarkably consonant with Newport *et al.*'s hypothesis that aspects of child speech can be facilitated by supporting a child's processing bias (i.e. listening to the beginnings of sentences). When the mother variables most related to the issue (i.e. sentence types, which vary as to which part of a sentence comes first) were considered, the correlations from the two studies compared favourably. The most significant of these correlations was between use of *yes/no* questions and growth of auxiliaries per verb phrase, which Newport *et al.* used to highlight their discussion of the child's processing bias. Our data agree with their interpretations and add another dimension to them; a significant correlation of *yes/no*–other correlations (most of which deleted frontal auxiliaries) with auxiliaries per verb phrase suggests that the absence as well as presence of frontal auxiliaries in particular sentences (namely, those in which mother used *yes/no* intonations) contributed to the listening bias, perhaps by facilitating discrimination of the two types.

The remainder of our significant predictors of child language growth are with the cluster of basic language variables, and seem comprehensible when placed in a general framework. They are congruent with the hypothesis that those aspects of motherese which reflect the use of a simpler communicative style were positively related to language growth, while the use of a more complex style was associated with relatively slower child language development. While such a conclusion has a tautological ring, it escapes such status by virtue of literature which allows us to define 'simplicity' independent of effects. We will first consider the concept of simplicity, and then show how our findings are consistent with it.

A simpler communicative style consists in use of constructions which are relatively simple syntactically and semantically, as well as stylistically. Of these domains, the one on which simplicity is most easily defined is syntax. By referring to a formal grammatical theory, complexity orderings among elements can be undertaken. Brown (1973) details this process when defining relative complexity of different grammatical morphemes, using Jacobs & Rosenbaum's (1968) transformational grammar. Briefly, Jacobs & Rosenbaum have only nouns and verbals represented in deep structures. Segment structure transformations introduce additional lexical features, by acting when nouns and verbal segments contain certain semantic features. At the utterance level, relative complexity can be defined by number of underlying propositions and number of deep structure elements. Relative complexity among surface elements depends on the number of segment structure features and transformations necessary to produce a morpheme in surface syntax.

Semantic simplicity is perhaps more basic than syntactic simplicity since, according to this theory, syntactic complications are introduced by semantic features. The two domains, therefore, are not independent, a fact amply demonstrated by the highly correlated relative orderings of the grammatical morphemes in syntactic and semantic complexity domains found by Brown (1973). Measures of semantic difficulty, however, go beyond the lexical features which might be associated with each basic entry. Language can also be simple or complex depending on how well it suits the cognitive capabilities of the receiver (in this case, a child). According to almost every cognitive-developmental theory (e.g. Piaget 1926), children have more difficulty with abstract as opposed to concrete concepts. Words with abstract referents are therefore expected to be more difficult than those with concrete ones. Semantic simplicity then consists of reference to those aspects of the world which the child can readily interpret. It is a 'here and now' language.

Finally, certain stylistic characteristics can be simpler than others. Phonological clarity allows a message to be easily received and is therefore simpler for the receiver. Unfortunately, simplicity cannot be defined for many other characteristics of interaction styles because there is no formal framework in which they can be compared. There have, however, been efforts to describe characteristics in addition to the use of simple semantic or syntactic constructions which are optimal for effective communication. These include mothers' sensitivity to children's attention span, interests and understanding, and her sensitivity to the meanings of the children's utterances.

On the whole, the negative correlations of mother speech at 1;6 with child language growth found in this study suggest that complexities in mothers' speech hindered language development. A greater number of words signals added syntactic complexity over shorted utterances, as well as a situation with a greater chance of semantic overload. Pronouns represent added complexity in speech in that they are syntactically more difficult than their alternative, nouns; in general, pronouns need more transformations before translation into surface structure is completed. They distinguish cases, specify gender, and specify number, in fairly regular fashion. In addition, the deictic characteristic of pronouns means that they are interchangeable among referents; they are thus semantically more obscure than nouns since they have no 'physical distinctiveness' and are low in 'imageability' (see Brown 1977, Rosch, Mervis, Gray, Johnson & Boyes-Braem 1976).

The negative relationship between verbs and child language growth can be understood semantically. According to Goldin-Meadow, Seligman & Gelman (1976) and Miller & Johnson-Laird (1976), verbs are less concrete and therefore semantically more difficult than nouns and in this study mothers used verbs to the relative exclusion of nouns (among mother variables, the noun–verb correlation was $r = -0{\cdot}65$, $P < 0{\cdot}06$). Likewise, copulas represent a more extreme

verb form which have no concrete referent at all. Additional complexity here is added syntactically since, according to Jacobs & Rosenbaum, copulas result from a transformation operating on verbals. Finally, it seems likely that the negative relationship between contractions and child language development results from the fact that this construction represents added complexity in the surface structure and may also indicate absence of phonological clarity.

On the other hand, factors positively related to language growth suggested brevity of (interjections) and relatively more concreteness in (nouns/nouns + pronouns) mothers' speech. On the whole then, our correlations are consonant with the notion that simple linguistic input to children at 1; 6 is conducive to language growth. This implication contrasts with the conclusion of Newport *et al.*, who claimed (1977: 136):

> In sum, whether mothers speak in long sentences or short ones, restricted or wide-ranging sentence types, complex sentences or simpler ones – none of these plausible candidates for a teaching style have a discernible effect on the child's language growth during the six month interval we investigated.

It is notable that complexities in the underlying structure of the different sentence types was not negatively related to language growth; indeed *yes/no* questions, especially those that were not regular inversions of sentence structure order, were positively correlated with language growth while the theoretically simpler declaratives were uncorrelated. That sentence modality complexities were not important to language learning at 1; 6 should not be surprising, since according to Brown (1973) the Stage I child is learning semantic roles and grammatical relations while the major simple sentence modalities are little in evidence. It would be inappropriate to assume that variations from canonical ordering of sentence constituents are an indication of increased complexity to the child when he is probably not attending to this dimension. This illustrates the difficulties inherent in distinguishing what is simple for the child at a given point from what is simple for the adult.

While sentence typing does not seem to play a role in language growth at this early age, significant correlations remain to be accounted for. It seems plausible that mothers' interaction style is the important variable among them. For example, *yes/no* questions, especially those with deletions, which include many *want to*...questions, might indicate a mother's optimal means for successfully communicating with her child via sensitivity to his needs and interests. It is not unreasonable to suggest that communicative success facilitates language growth; indeed, we would be surprised if the benefits of simple speech did not derive at least in part from being linked to successful communication.

A potential complication to our interpretations is the significant correlations of children's speech comprehension at 1; 6 with both mothers' speech at 1; 6 and their own productive language status at 2; 3. This enters a third variable

that may be acting as a causitive factor in these relationships. However, it seems most plausible that the relationship rests on the simplicity of mothers' speech. That is, children understand mothers who speak more simply at 1; 6 and these mothers in turn affect productive language development. The alternative, that children's superior comprehension induces a simpler language on the part of the mother is less plausible. Indeed, the opposite relation is usually posited (Shatz & Gelman 1973). In essence, the correlation between early comprehension and the other factors suggests that motherese may be affecting child language development far earlier than the production data (which shows no concurrent effects) reveal. Indeed, it is possible that the child's comprehension competence is the 'carrier' of the mother's influence from one period to the next. These relationships deserve further investigation.

Benefits of motherese. The distinctiveness of the motherese code has been thought to result from mothers' attempts to communicate effectively with their children (Brown 1977, Newport 1977). Given this, and our contention that language development is facilitated by a simple and thus successful communicative style, one would expect that motherese differs from adult–adult speech in ways which facilitate language growth. Empirically, this would mean that on variables for which motherese had a mean score less than that for adult–adult speech (e.g. MLU in motherese is smaller than that between adults), negative correlations between the use of those variables and language growth are predicted; where motherese had a higher mean on a given variable (e.g. number of *yes/no* questions) positive correlations are predicted. Our study allows a test of these predictions, which is shown in Table 6. Listed in the first three columns are (*a*) the variables

TABLE 6. *Variables for which effects on child language acquisition were predicted*

Variables	Direction of difference [a]	Predicted sign [b]	Obtained
Declaratives	<	−	−0·26
Imperatives	>	+	0·06
Wh–questions	>	+	−0·37
Yes/no questions	>	+	0·72*
Fragments (interjections)	>	+	0·57
Deletions (*yes/no* other)	>	+	0·77*
Mean length utterance	<	−	−0·69*
Sentence nodes/utterance	<	−	−0·53
Pronouns/utterance	<	−	−0·75*
Verbs/utterance	<	−	−0·71*
Modifiers/utterance	<	−	−0·42
Contractions/utterance	<	−	−0·65

[a] Magnitude of measure of variable in mother–child speech is > or < that in adult–adult speech.

[b] Predicted sign of the correlation between each measure and subsequent child language growth.

* $P < 0{\cdot}05$, one-tailed.

in this analysis on which differences between motherese and speech between adults have been reported (Newport 1977 and Phillips 1973 were source studies), (*b*) the direction of differences (motherese usage > or < that in adult–adult speech), and (*c*) the predicted signs of the correlations. (The table includes in parentheses our label for a variable when it differed from that of the previous investigator. In these instances, our variables were defined somewhat differently than in the original study, although the essence of what was measured remained the same.) Twelve predictions were made. The fourth column shows the correlations obtained between mothers' speech on the 1;6 measures and children's 2;3 MLU. Eleven of the twelve of the predictions were in the expected direction. Only *wh*-questions, which were expected to aid language development (given that they are more frequently used in motherese), violated expectations. The magnitude of the predicted correlations was generally impressive; 5 of the 11 predicted effects were significant.

It is apparent then that mothers adjust their speech to children in ways which facilitate language growth. We do not mean to imply that mothers have any intent to teach language when using their special code, but we do suggest that, even though they may use it to serve other functions such as effective communication, motherese is an effective teaching language. Our data on this point are not comprehensive enough to constitute a definitive test of the functional effects of using motherese, but they do suggest an interesting relationship between the motherese code, effective communication and child language development which warrants further study.

CONCLUSION

Regardless of whether our speculations as to the form of these relationships prove accurate, our study has successfully demonstrated that variation in the natural linguistic environment is associated with variation in children's speech progress. This finding complements the recent experimental exploration of environmental influences on the learning of specific forms (e.g. K. E. Nelson, Carskaddon & Bonvillian 1973, K. E. Nelson 1977*a*). The experimental literature by itself could not demonstrate that particular inputs are necessary to the acquisition of particular forms but only that under some circumstances they are sufficient. The present demonstration supports the conclusion that not only CAN input make a difference but that it DOES. In addition, the present findings suggest new areas for experimental manipulation. For example, decreasing the use of pronouns and the copula while increasing noun use over the early period of grammatical development would be expected to lead to increases in the complexity of children's speech forms.

In conclusion, we would stress the conceptual and methodological point from which this study departed: environmental effects on language development

cannot be evaluated independently of the child's current state of development because what is an effective input to the child depends crucially on how it fits the child's extant language system. What leads to a change in the system at one point in development may be completely ineffective at another point. Nor can these complexities be made to vanish through statistical manipulation. To understand changes in a dyadic system one must take into account all parts of the system and their impact on one another at different points in development. Although we think we have advanced this cause to some degree we are far from a formal theory of environmental effects on language growth. Much remains to be established with respect to what mothers do that makes a difference at different points in their children's language development.

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