

Correlates and antecedents of maternal expansions of utterances of children with language disabilities

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Abstract

Fifty-one children with language delays, and their mothers, were studied to identify characteristics of the children's utterances that potentially influence an aspect of maternal linguistic input: expansions. A subset of 33 of these dyads was studied and submitted to sequential analysis to identify the types of child utterances mothers were most likely to expand. Twenty-minute mother-child free-play sessions were videotaped and transcribed. Trained observers coded utterances for child intelligibility, child topic maintenance, adult expansions, and adult non-expansions. The extent to which mothers expanded child utterances increased with increasing child mean length of utterance (MLU) and intelligibility. Moreover, mothers expanded multiword fully intelligible child utterances more than they did partially intelligible or single-word child utterances. The implications of the results for language intervention and future research are discussed.

Keywords: child language, language delay, maternal language

Introduction

Child behaviours that elicit linguistic input that in turn facilitates child language development have been called 'eliciting bootstrapping operations' (Shatz, 1987). The types of child utterances that are associated with mothers' use of language-

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facilitating behaviour are one type of eliciting bootstrapping operation. One type of language-facilitating behaviour that naturally occurs in mother-child interaction is expansions.

In this study, expansions are adult utterances that repeat an element of the child's preceding utterance, adding semantic or syntactic information. For example, if the child says 'Ball' and the following adult utterance is 'You want the ball?', the adult's utterance is an expansion. Our definition of expansion includes what others (e.g. Snow, Perlmann and Nathan, 1987) call 'recasts' (i.e. a reply that structurally changes one or more major components of the child's utterance). For example, if the child says 'I want ball', an adult recast might be 'You want the ball, don't you?' or 'Do you want the ball?'. Expansions are a subset of 'topic continuations' (i.e. adult utterances that maintain the main idea or relationship between ideas in the previous child utterance).

Expansions may be particularly powerful carriers of analysable linguistic information, because they add semantic or syntactic information to the child's previous utterance. The temporal proximity and semantic overlap of the adult and child utterances may in turn help the child understand and notice the differences in the utterances. Such cognitive comparisons between the child's and adult's utterances may be helpful in facilitating grammatical development (Nelson, 1989). Internally valid intervention studies have shown that expansions facilitate grammatical development in children without disabilities (Nelson, 1989), in children with specific language impairment (Camarata, Nelson and Camarata, 1995), and in children with mental retardation (Yoder, Spruytenburg, Edwards and Davies, 1995).

Mother-child interaction studies of children who are typically developing (Cross, 1977, 1978; Liebergott, Menyuk, Schultz, Chesnick and Thomas, 1984) and those having language impairments (Conti-Ramsden, 1990) indicate that mothers vary greatly in their use of expansions. Naturalistic studies also show that variation in the use of expansions is associated with individual differences in later language development (Barnes, Gutfreund, Satterly and Wells, 1983; Snow *et al.*, 1987 for review).

Three decades of research on mother-child interaction suggest that children affect parents as much as parents affect children (e.g. Bell and Harper, 1977 for review and theory). Therefore, one reason mothers may vary in the extent to which they use expansions may be that their children produce utterances that differ in ways that influence the probability that they will be expanded.

The goal of this study was to identify characteristics of children's utterances that are associated with, and precede, maternal expansions in children with language delays. Professionals working with children who have language delays are in need of knowledge of how discourse factors influence the use of language-facilitating behaviours. Such knowledge may help identify language goals that may improve the efficiency of language intervention. For example, if we find that mothers expand multiword utterances more than single-word utterances, the rationale for targeting the semantic relations underlying multiword utterances is strengthened. Increasing semantic relation use might increase the proportion of child utterances that are expanded, and in turn facilitate subsequent grammatical development. Generalizing from the results of studies of children who do not have disabilities may be inappropriate, since Conti-Ramsden (1990) found that parents of children with specific language impairment recast their children's utterances for different reasons than those of parents with children without disabilities.

The present literature on the different types of utterances which mothers expand assumes that the pragmatic function of the expansion should predict which utterances mothers expand (Furrow, Baillie, McLaren and Moore, 1993). In this pragmatic model it is predicted that mothers will expand grammatically ill-formed utterances more than grammatically well-formed utterances. This has been empirically confirmed in samples of normally developing children (Furrow *et al.*, 1993). Presumably, this occurred because mothers expand most frequently to confirm or correct the child's preceding utterance. If this were the case with children with language delays, then one would expect mothers to need to confirm or correct child utterances more frequently after short or partially intelligible utterances. In the only study of the pragmatic functions of recasts, of which expansions are a type, Conti-Ramsden (1990) found that mothers of normally developing children and mothers of children with language delays almost never used recasts to provide negative feedback on their children's prior utterance. Additionally, mothers of children without language delays used recasts to request clarification almost twice as much as did mothers of children with language delays. Therefore, mothers of children with language delays may expand different types of utterances than do mothers of children without language delays.

Our model for predicting which utterances mothers of children with disabilities might be most likely to expand is different from that which presently exists in the literature. We submit that there is no reason to assume that systematic relations between child utterances and maternal expansions are due only to the pragmatic function of maternal expansions.

Because expansions repeat at least one major element of the child's previous utterance, at least some of parents' attempts to continue their children's topic are likely to be expansions. We posit that expansions may occur relatively more often when children's utterances are more easily understood, and have relatively more intelligible major elements. The adult must understand at least the general topic of the child's utterance to continue it. Additionally, the more intelligible elements the child's utterance contains, the greater the probability that the adult's topic-continuing utterance will contain at least one major element of the child's utterance and thus be classified as an expansion.

One prediction that grows out this model is that parents may be more likely to expand child topic-continuing utterances than topic-initiating utterances. Child continuations may be easier to understand than topic initiations, particularly in marginally intelligible children or children in the early stages of language learning (Yoder, Davies and Bishop, 1994a). Because a subset of these adult topic-continuing utterances will be expansions, parents may expand child topic-continuing utterances more than they expand child topic-initiating utterances. No existing research has tested whether mothers expand child topic-continuing utterances more than child topic-initiating utterances.

Additionally, mothers may expand fully intelligible and multiword child utterances more than partially intelligible and single-word utterances. Fully intelligible multiword child utterances have more intelligible major elements than single-word or partially intelligible utterances. Therefore, it is more probable that adult topic-continuing utterances will repeat a major clause element of a preceding fully intelligible multiword child utterance than of a preceding child utterance with fewer intelligible major elements (e.g. partially intelligible or single-word utterances).

In terms of empirical support for our model, Yoder *et al.* (1994a) found that parents of children with developmental disabilities in the single-word stage were more likely to continue their children's topic after child topic continuations than after child topic initiations. Expansions are a subset of topic continuations. With regard to our prediction that mothers expand intelligible utterances more than partially intelligible utterances, Conti-Ramsden (1990) found a positive correlation between proportion of child utterances that were intelligible and mothers' use of a particular type of recast in parents of children with language delays. Expansions, as we define them, are a subset of what Conti-Ramsden (1990) called recasts. Although the Conti-Ramsden (1990) finding does not necessarily mean that mothers of children with language delays expand intelligible utterances more than partially intelligible utterances, her finding is consistent with this explanation. There have been no studies that test the prediction that maternal expansions are more likely to occur after child multiword utterances than after child single-word utterances.

The data for the present study were examined both at a summary level and at a sequential level of analysis. At the 'summary level' we predicted that three child variables would be positively associated with the proportion of child utterances that mothers expanded. By 'summary level' we mean that the data used to test these predictions are based on frequencies or averages across utterances, without regard to the sequence of utterances. In contrast, the 'sequential level' of analysis means that the data analysed must reflect the sequence of utterances. In the current study the sequential analyses reflect the sequence of child utterance and adult expansion. By making the distinction we can be more precise in examining why certain associations occur. For example, although Conti-Ramsden (1990) found a summary level correlation between percentage of child utterances that are intelligible and proportion of child utterances that are expanded, this finding does not necessarily mean that mothers expand intelligible utterances more often. It simply means that children with relatively high intelligibility have mothers who expand relatively many of their children's utterances. The summary level child variables that we examined were: (a) the proportion of child utterances that continue the established topic, (b) the proportion of child utterances that were intelligible, and (c) mean length of utterance (MLU).

Three predictions were examined at the sequential level of analysis. First, we expected maternal expansions to follow child topic continuations more than child topic initiations. Second, mothers were expected to expand multiword utterances more than single-word utterances. Third, we predicted that mothers would expand fully intelligible utterances more than partially intelligible utterances. Just as summary level analyses do not inform us about sequential relations, sequential relations do not necessarily reveal summary level relations. That is, it is possible for mothers to expand multiword utterances more than single-word utterances, but for the proportion of child utterances that mothers expand to be unrelated to child MLU.

Finally, we also explored individual differences in the extent to which these three aspects of child utterances (i.e. topic maintenance, intelligibility, and length) were related to maternal expansions at the summary and sequential level of analysis. These predictions were tested in children with language delays in the single-word to complex sentence stages of language learning.

Methods

Participants

We studied 51 mothers and their children with language disabilities. The mother-child interactions that were investigated in this study were originally collected as part of three studies (Hooshyar, 1987; Klee, Schaffer, May, Membrino and Mougey, 1989; Yoder *et al.* 1994a) in order to maximize the sample size. These databases were aggregated because of their methodological similarities: they all studied parent-child interaction with children who had disabilities and used a similar data collection and transcription format.

All children in the sample had language abilities that were below those expected for their chronological age, and which were deemed by professionals to require intervention. Presence of language delay was determined by selecting sessions from the original database in which the children had MLU that were at least 1.5 standard deviations below that expected for their chronological age using the Miller and Chapman (1981) data set and regression equation. To make the subsamples from the three laboratories as comparable as possible, sessions were selected that met the following criteria. The selected sessions (a) were 20 minutes long, (b) were between child and mother only, and (c) had at least 50 intelligible utterances. Finally, for the purposes of the current study, children with Down syndrome were excluded from the sample. Children with Down syndrome were explicitly excluded because there is reason to believe that different discourse processes may occur in such dyads (Miller, Leddy, Miolo and Sedey, 1995).

The resulting sample included 21 children from Klee *et al.* (1989), 14 children from Hooshyar (1987), and 16 children from Yoder *et al.* (1994a) (i.e. $n=51$). Hooshyar (1987) described her sample as being middle-class, as defined by Hollingshead (1974). Klee *et al.* (1989) indicate that their sample had a wide range of occupational levels with a mean level at the middle-class level, as defined by Duncan's Socioeconomic Index (Mueller and Parcel, 1981). The Yoder *et al.* (1994a) sample had a wide range of occupational levels with an average occupational level that was very similar to the general population's, using the *International Standard Classification of Occupations* (1986). Table 1 indicates the children's mean length of utterance (MLU) and the chronological age (CA) in months at the time the data were collected. The expressive and receptive age-equivalent scores were computed from two different tests because the original data were collected by different investigators. The consequence is that the expressive and receptive age-equivalent scores can be used only for participant description purposes, not analyses purposes.

Table 1. Means standard deviations of selected descriptor variables for the children in the primary sample ($n=51$)

Variables	Mean	SD	Range
Chronological age	42 months	9 months	25-112 months
MLU	2.03	0.65	1.05-3.7
Expressive age ^a	30 months	8 months	17-89 months
Receptive age ^a	33 months	9 months	16-94 months

^a Estimated from the Sequences Inventory of Communication Development (Hedrick, Prather and Tobin, 1975) and Vineland Adaptive Behavior Scales (Sparrow, Balla and Cicchetti, 1984).

However, such scores concur with MLU scores in documenting the sample as delayed below the level expected for their chronological age.

The selected sample represented a heterogeneous mix of language-delayed children with regard to aetiological and linguistic characteristics. Although a portion of the sample had been diagnosed as specifically language-impaired ($n = 21$; from Klee's laboratory), the non-verbal cognition and hearing status of the remainder of the sample was not examined. Thus, some participants may have had other problems in addition to their language delays.

Some discussion on the possible consequences of testing our hypotheses in a heterogeneous sample is warranted. If our results support our hypotheses in such a heterogeneous sample, it is possible that we may overgeneralize our results to subgroups in which the hypothesized relations do not occur. For the sake of explanation, let us assume that one subgroup has the predicted relationships and another subgroup does not. If the subgroup without the predicted relationships is composed of the minority of the sample, then the analyses on the whole sample might be significant and the reader might be tempted to overgeneralize the results to all language-delayed children. We have tried to reduce the probability of overgeneralization in two ways. First, we have examined whether the strength and direction of the sequential-level relationships are a function of MLU and intelligibility of the children. Second, we excluded a sample of children for which we expected systematic differences in the types of utterances mothers might expand (i.e. Down syndrome children) to examine in a separate study. In the final analysis, samples in all studies are heterogeneous on some variables. The process of science is to determine which variables influence the relationships of interest. We have placed our bet on MLU and intelligibility, to help prevent us from overgeneralizing. If the results of the analyses on the entire sample do not support our hypotheses, but the relationships really do exist in a minority subgroup of the sample, then the results would be placed in that large category of uninterpretable results.

Procedure

Mother-child free-play sessions

All sessions were 20-minute free-play sessions between one child and his/her mother. The location of the session was either in the child's home (Hooshyar, 1987) or in a laboratory (Klee *et al.*, 1989; Yoder *et al.*, 1994a). The toys were either the child's toys (Hooshyar, 1987) or provided by the experimenters (Klee *et al.*, 1989; Yoder *et al.*, 1994a). In all cases the mothers were instructed to 'play with your child as you normally do'. No other instructions were given. In the sessions conducted by Yoder and colleagues (1994a) and by Klee and colleagues (1989), the camera was controlled by remote control or through a one-way window. All sessions were videotaped. The Yoder *et al.* (1994a) and Klee *et al.* (1989) sessions were also audiotaped for later transcription. In the sessions conducted by Hooshyar and colleagues (1987), the camera person was in the room with the child and mother.

Transcription and coding

The tapes of the mother-child sessions were transcribed verbatim using the Systematic Analysis of Language Transcripts (SALT, Miller and Chapman, 1986) format. Observers coded the transcribed utterances while viewing the videotaped session for contextual information. Coders did not change the original transcriptions,

because doing so would render the reliability estimates on the transcriptions uninterpretable.

Human observers coded child utterances for topic maintenance (continuation and initiation) and adult utterances for whether they were expansions or not from the transcripts and videotapes. Table 2 contains the categories, definitions, and examples of the categories that observers coded from transcripts.

A customized computer program coded each child utterance for intelligibility and length. Intelligibility coding had three possible categories: (a) unintelligible (i.e. the transcriber was unable to interpret any of the child's speech in an utterance); (b) partially intelligible (i.e. the transcriber interpreted at least one speech segment as an English word, but could not interpret at least one other vocalization as a particular English word within the same utterance); or (c) fully intelligible (i.e. the transcriber was able to interpret the entire utterance). Length coding had two possible categories: single-word utterances and multiword utterances (i.e. two or more words).

Table 2. *Definitions and examples of categories which observers coded from the transcripts and videotapes*

Categories	Definition	Examples
Parental utterances Expansions [exp]	Parental utterance occurring immediately after a child utterance that is at least partially intelligible <i>and</i> uses a major clause element from the child utterance <i>and</i> adds semantic or syntactic information. Adding information occurred in the form of adding words or morphemes <i>or</i> changes order of the child's words.	C: The barrel fell. P: Yes, the brown barrel fell down [exp]. C: Broke. P: The truck broke [exp]. C: Is the truck broke? P: The truck is broken [exp].
Non-expansions [non]	Parental utterances that occur after other adult utterances <i>or</i> those that occur after child utterances that are unintelligible <i>or</i> those that occur after partially or fully intelligible child utterances but do not (a) repeat at least one major element of the child's utterance or (b) add semantic or syntactic information.	C: Train. A: Train [non]. C: Train goes. A: Yeah, goes [non]. C: Train. A: It goes to my house [non]. C: Train. A: I've got a box car [non]. C: Train. A: I want to go home and eat [non].

Table 2. (continued)

Categories	Definition	Examples
Child utterances		
Topic continuations [con]	The child's utterance continues the same topic as that in the previous utterance. The topic is continued when the utterances refer to the same or related objects or actions.	A: I have a truck. C: Truck [con]. A: I have pegs. C: Well, I have the board [con]. A: Let's play with the people. C: {puts people in bus} And the bus [con]. A: The people are going in the bus. C: {child pushes bus to store} Go to store [con].
Topic initiations and reinitiations [ini]	The child's utterance introduces a topic that is different from and not related to that of the preceding utterance <i>or</i> continues a topic that has not yet been continued by the partner.	A: I drive the truck. C: I can say my ABCs [ini]. A: I like the trucks. C: I like balls {goes to get ball} [ini]. C: I like the balls. C: Roll ball {pushes to adult} [ini].

C = child; P = parent.

Reliability

Transcription reliability

Hooshyar (1987) stated that utterance-by-utterance inter-observer agreement of the transcription was estimated by having two transcribers independently transcribe 10 sessions. Observers transcribed the remaining videotapes in the Hooshyar (1987) sessions after agreement on the transcription of the utterance was approximately 1.0. Klee *et al.* (1989) estimated inter-observer agreement of their transcripts by retranscribing 25% of their sessions. Using the reliability method described in Miller and Smith (1983), Klee *et al.* (1989) reported 88.25% agreement between pairs of independent observers (range 81–93%). Yoder *et al.* (1994a) estimated inter-observer agreement of their transcripts on 15% of their sessions. In the Yoder *et al.* (1994a) sample, the mean percentage agreement was 93% (SD = 0.08) on the following variables: segmentation of utterances, utterance level transcription agreement, judgement of intelligibility, and speaker code.

Reliability of coded categories

Utterance-by-utterance inter-observer agreement on each observed category was estimated using kappa (Bakeman and Gottman, 1986). Kappa estimates agreement after controlling for chance agreement. The reliability sample was 11 sessions (22% of the sample of 51). The kappas were as follows: adult expansions and non-expansions (mean=1.0; SD=0.01; range=1.0–0.96); child continuations (mean=0.97; SD=0.03; range=1.0–0.89); initiations (mean=0.80; SD=0.09; range=0.61–0.89).

Group analyses

We used Pearson's r to investigate the strength of the relationships between two variables (e.g. children's MLU and maternal expansions). The t -test was used to determine the significance of these associations. Multiple regression was used to examine whether the relationship of one predictor (e.g. child MLU) and maternal expansions changed depending on another predictor (e.g. intelligibility of child utterances). We used paired t -tests to compare two sequential dependencies. A sequential dependency is the extent to which one behaviour (e.g. adult expansion) follows another behaviour (e.g. child multiword utterance) controlling for the sequencing of behaviours due to the two behaviours total occurrence in the session. Using the various types of child utterances as the within-subjects factor, we used repeated-measures MANOVA to compare more than two sequential dependencies simultaneously. If the MANOVA revealed a significant effect for type of child utterance, Duncan's multiple-range tests using the within-subject's error term were used to specify the sequential dependencies that differed from each other.

Summary-level analyses

There were two types of variable scores entered into the group analyses: summary-level scores and sequential-level scores. Summary-level scores are frequencies, averages, or proportions that do not reflect the sequence of utterances. The variables used for the summary-level analyses were: (a) child MLU, (b) proportion of child utterances that were fully intelligible, and (c) proportion of child utterances that continued the previous topic of conversation.

Sequential-level analyses

Sequential-level variables are those that reflect the sequence of utterances. The variables used for the sequential-level analysis were: (a) proportion of child utterances that adults expanded and (b) various indices representing the degree of sequential dependency between a particular type of child utterance and adult expansions. To conduct group-level analyses with sequential data, an index of sequential dependency was derived for each mother–child pair and for each sequential pattern to be compared. These indices were the dependent scores in parametric analyses. For example, we used a paired t -test to examine whether the sequential dependency between expansions after multiword child utterances was greater than that for expansions after single-word child utterances.

The index of sequential dependency that we used in these parametric analyses varied depending on the research question. If we wanted to know whether mothers expanded one type of utterance more than other types of child utterances, we used z scores based on a 2×2 contingency table analysis. The 2×2 contingency table

was a tally of expansions and non-expansions after the particular type of child utterance, or after some other utterance type (Allison and Liker, 1982). The z score has been used as a dependent variable score in parametric analyses in several sequential analysis studies (see Gottman and Roy, 1990 for examples). We used ϕ (Appelbaum and McCall, 1983) as the index of sequential dependence when testing whether a single sequential dependency varied, or the difference between two sequential dependencies varied, as a function of some child characteristic[†].

Dyadic level of analysis

We tested whether the extent to which mothers expanded various types of child utterances occurred significantly more than was expected by chance. Doing so helps identify relations that are worth investigating in the future with experimental manipulations of the antecedent utterance. When testing whether mothers expanded a particular type of child utterance more than expected by chance processes, we used a novel application of resampling tests (Bakeman and Robinson, 1995; Yoder *et al.*, 1994a,b; Yoder, Davies, Bishop and Munson, 1994c; Yoder and Tapp, 1993). This application of resampling tests compares the observed number of times mothers expand a particular type of utterance (i.e. observed sequential frequency) with what would occur in a random sequence of utterances[‡].

[†] With regard to testing whether a single sequential dependency or the difference between two sequential dependencies varies as a function of some child characteristic (i.e. MLU or intelligibility), z scores are not an appropriate index of sequential dependency to use as a dependent variable score in parametric analyses. The z score varies as a function of the total number of utterances in the data-collection session, even when the sequential dependency between the relevant events remains the same (Wampold, 1992; Yoder and Tapp, 1990). That is, z scores can vary by some child characteristic simply because the child characteristic co-varies with amount of parent and child talking, not because the sequential dependency co-varies with the child characteristic (Yoder and Tapp, 1990). Instead of z scores, ϕ was used as the index of sequential dependency for this purpose. Yoder and Tapp (1990) showed that ϕ does not vary with total number of utterances, but does quantify sequential dependency. When used as a score in a parametric comparison of sequential dependencies on a group level, Monte-Carlo studies have shown that ϕ is a less biased, more symmetrically distributed parameter than is another index of sequential dependency (transformed kappa; Wampold, 1992; Bakeman, McArthur, Baldwin and Quera, 1995). Additionally, ϕ allows the simple frequency of antecedent and consequent events to influence its magnitude; a third index of sequential dependency does not (i.e., Yule's Q ; Bakeman *et al.*, 1995).

[‡] Resampling tests use a three-step process to test the significance of sequential dependencies. First, after counting the observed sequential frequency, the computer program randomly shuffles the sequence of utterances with the constraint that expansions cannot occur after other adult utterances. Second, the computer program counts the number of times expansions occur after the particular type of child utterance in the shuffled utterance stream (i.e. post-shuffle sequential frequency). Third, this shuffle-and-count process is repeated 1000 times. The number of post-shuffle sequential frequencies that are equal to, or exceed, the observed sequential frequency divided by 1000 equals the probability value of the observed sequential frequency. If over half of the sample had a significant sequential dependency then we considered the sequential dependency to be replicable. If under half had a significant sequential dependency then situations in which that particular sequential pattern occurs more than others are best ignored. That is, non-significant positive z scores could have occurred because of sampling error. A Monte-Carlo study has shown that resampling tests are slightly more conservative than z scores in testing the significance of sequential dependencies (Yoder and Tapp, 1993). The term 'sampled permutation tests' has also been used to describe this method of testing the significance of sequential dependencies (Bakeman and Robinson, 1995).

Results

Descriptive statistics for primary sample (n=51)

Before testing the hypotheses, we present statistics to summarize the extent to which mothers expanded their children's utterances. On average, expansions comprised 8% of mothers utterances (SD=4%). The rate of maternal expansions averaged 1.3/minute (SD=0.84/minute). Mothers expanded, on average, 12% of the children's utterances, with substantial variability between dyads (SD=7%). The following suggest two variables that account for some of this variance.

Correlates of expansions

We expected topic maintenance, MLU, and intelligibility to be positively associated with mothers' use of expansions. Contrary to our prediction, the percentage of child utterances that mothers expanded was not significantly related to the proportion of child utterances that were topic continuations, regardless of the MLU or intelligibility of the child. Additionally, there was no evidence that maternal expansions were predicted by an interaction between either MLU and continuations or intelligibility and continuations. Therefore, topic maintenance was not included in any further summary-level or sequential analyses.

As expected, MLU ($r=0.31$; $p=0.02$) and intelligibility ($r=0.30$; $p=0.03$) were positively associated with maternal expansions. However, note that these relationships are considered 'low' to 'moderate' (Cohen, 1977). The relation between MLU and intelligibility was non-significant ($r=0.19$; $p=0.17$). The interaction of intelligibility and MLU in predicting maternal expansions was non-significant.

Reducing the sample to those appropriate for sequential analysis

To test the sequential-level hypotheses we reduced the sample to those dyads that had at least 10 instances of each of the proposed antecedents (i.e. multiword, singleword, partially intelligible, and fully intelligible utterances) and at least 10 instances of expansions. We reasoned that if there were fewer than 10 instances of critical behaviours, predicted relationships could not be detected. This rule of thumb is similar to that used by other researchers who use sequential analysis (Roger Bakeman, personal communication, June 1994).

Thirty-three dyads met the criteria for sequential analysis. This subsample of children had the following characteristics: mean chronological ages of 44 months (SD=9 months), mean MLU of 2.17 (SD=0.67), mean expressive age-equivalent scores of 32 months (SD=8 months), and mean receptive age-equivalent scores of 34 months (SD=8 months). The subsample that was excluded from the sequential analyses ($n=18$) talked less often ($t=3.23$; $p=0.002$), had shorter MLU ($t=2.11$; $p=0.04$) and was *more* intelligible ($t=-2.2$; $p=0.03$ with pooled variance estimate because of unequal variances) than the sample used for sequential analyses ($n=33$). It is probable that these 18 children did not meet the criteria for sequential analysis, because they did not talk as often as the other 33 children included in the sequential analysis.

Sequential analyses

The mothers in the subsample of 33 expanded at about the same rate and about the same proportion of children's utterances as the larger sample of 51. The following results indicate at least one reason why MLU and intelligibility accounts for variance in the extent to which mothers expand their children's utterances.

Length

We predicted that mothers would be more likely to expand multiword utterances than to expand single-word utterances. Implicit in this prediction is the expectation that mothers expand multiword utterances more than would be expected by chance.

Using resampling tests we found that all mothers expanded multiword child utterances significantly more than expected by chance. However, the extent to which mothers expanded single-word child utterances varied as a function of the child's MLU (point biserial $r = -0.61$; $p < 0.001$). Specifically, 12 of the 33 mothers expanded single-word utterances significantly more than was expected by chance. These 12 mothers all had children with MLU below 2.0. Additionally, only one of the 21 mothers with children whose MLU were above 2.0 expanded single-word utterances more than expected by chance.

Mothers expanded multiword utterances (mean z score = 8.7; $SD = 2.01$) more than they expanded single-word utterances (mean z score = 0.84; $SD = 2.36$; paired $t = 11.06$; $p < 0.05$). The difference in the degree to which mothers expanded multiword utterances over single-word utterances varied as a function of child MLU ($r = 0.48$; $p < 0.05$). This occurred because the extent to which mothers expanded single-word utterances was negatively related to child MLU ($r = -0.63$; $p < 0.001$). That is, as children's MLU increased, mothers tended to expand their single-word utterances less. Even so, all mothers except one expanded multiword utterances more than single-word utterances. However, the results in the next two sections indicate that a probable interaction of intelligibility and length occurred. Therefore, these main effects for length should be interpreted with caution.

Intelligibility

We predicted that mothers would be more likely to expand fully intelligible utterances more than partially intelligible utterances. Implicit in this prediction is the expectation that mothers expand fully intelligible utterances more than would be expected by chance.

Using resampling tests we found that all mothers expanded fully intelligible utterances significantly more than chance; whereas only 15/33 mothers expanded partially intelligible utterances more than chance. In general, mothers expanded fully intelligible child utterances (mean z score = 6.67; $SD = 2.83$) more than they expanded partially intelligible child utterances (mean z score = 1.65; $SD = 2.04$; paired $t = 11.15$; $p < 0.05$). However, the difference in the degree to which mothers expanded fully intelligible utterances more than partially intelligible utterances was positively related to child MLU ($r = 0.41$; $p < 0.05$). Even so, all mothers except one expanded fully intelligible utterances more than they expanded partially intelligible utterances. In the next set of analyses we considered intelligibility and length simultaneously, to shed light on why this complex pattern of results occurred.

Length and intelligibility considered simultaneously

Mothers differ in the degree to which they expand the four types of child utterances ($F=119.7$; $p=0.0001$). The order of the sequential dependency is presented in Table 3.

Mothers tended to expand multiword fully intelligible utterances more than multiword partially intelligible utterances, which in turn were expanded more than single word-utterances. It should be noted that 'partially intelligible single-word utterances' were child utterances with only one intelligible word and at least one unintelligible vocalization. Therefore, partially intelligible single-word utterances were not marginally intelligible utterances with only one word. Resampling tests indicated that, in all but one dyad, mothers expanded fully intelligible multiword child utterances more than random sequencing of utterances would predict. Mothers expanded all other types of child utterances at or below chance levels in more than half the dyads.

However, it should be noted that many subjects had very few multiword partially intelligible child utterances (i.e. 15/33 had fewer than 10). Even more subjects had very few single-word partially intelligible child utterances (i.e. 19/33 had fewer than 10). When there are few instances of the antecedent behaviour it is difficult to detect a pattern that might be evident in a longer sample of behaviour. Therefore, a second strategy was used to test the relative sequential dependency and significance of the sequential dependencies of expansions after the four types of child utterances. In this strategy the sample was reduced to those dyads with at least 10 instances of all four types of child utterances. This reduced the sample to nine dyads.

The results of the comparison of the extent to which mothers expanded the four different types of child utterances are presented in Table 4. The repeated-measures MANOVA indicated that there was a difference in the extent to which mothers expanded the four types of child utterances ($F=14.97$; $p=0.003$). A Duncan's multiple-range test using the within-subjects error term indicated that mothers expanded fully intelligible multiword child utterances more than any other type of utterance. The remaining utterance types were expanded about equally in this reduced sample.

Resampling tests indicated that all nine mothers expanded fully intelligible multiword child utterances more than expected by chance. In contrast, mothers expanded

Table 3. Means and standard deviations of the z scores of maternal expansions after various types of child utterances ($n=33$)

Variables	Means for z scores	SD of z scores
Expansions of multiword fully intelligible utterances	8.55 ^a	2.96
Expansions of multiword partially intelligible utterances	1.51 ^b	2.01
Expansions of single-word partially intelligible utterances	0.65 ^b	1.76
Expansions of single-word fully intelligible utterances	0.64 ^b	2.18

a > b at the 0.05 level.

Table 4. *The z scores and probability value for the sequential dependencies between maternal expansions and the four types of child utterances in the reduced sample (n=9)*

Sequential pattern	z scores	p from re-sampling tests
Expansions of multiword fully intelligible utterances	9.24 ^a (3.67)	0.000 (0)
Expansions of multiword partially intelligible utterances	2.30 ^b (1.88)	0.10 (0.11)
Expansions of single-word fully intelligible utterances	1.17 ^b (1.87)	0.56 (0.43)
Expansions of single-word partially intelligible utterances	1.85 ^b (2.42)	0.28 (0.35)

a > b at the 0.05 level.

Numbers in parentheses are standard deviations; others are means.

the other three types of child utterances at or below chance rates in more than half of the nine subjects.

Therefore, there is convergence between the results of the analyses on the two subsamples. Mothers expanded fully intelligible multiword child utterances more often than was expected by random sequencing of utterances. Additionally, mothers expanded fully intelligible multiword child utterances more than partially intelligible multiword utterances and more than single-word utterances.

Post-hoc analyses

We investigated the possibility that the above summary- and sequential-level relationships were of different magnitudes or directions in children with SLI than in the other children in the sample. Separate analyses on each subsample produced the same correlates and ranking of antecedents of expansions across subsamples, and is the same as is reported above.

Discussion

We predicted that child topic maintenance, intelligibility, and MLU would be positively correlated with the proportion of child utterances that mothers expand. We also expected maternal expansions to follow topic continuations, multiword utterances, and fully intelligible utterances more than topic initiations, single-word utterances, and partially intelligible utterances, respectively. As predicted, the results indicated that children with relatively high MLU and children with relatively high intelligibility tended to have mothers who expanded proportionally more of their children's utterances. However, we must consider both length and intelligibility simultaneously to predict which types of child utterances mothers expand. Mothers tended to expand multiword utterances more than single-word utterances only if the multiword utterances were fully intelligible. From another perspective, mothers tended to expand fully intelligible utterances more than partially intelligible utterances only if the child utterances contained more than one word. Finally, mothers

expanded fully intelligible multiword child utterances more than was expected by chance in almost all cases. In contrast, mothers expanded partially intelligible multiword child utterances or single-word utterances at or below chance levels in more than half the cases.

It was surprising that topic continuations were not more likely to be expanded than were topic-initiating utterances. We predicted that mothers would continue, and sometimes expand, the children's topic-continuing utterances more than topic-initiating utterances because we assumed in the former it would be easier to identify the topic than it would be in the latter utterance type. Our interpretation was guided in part by past research with children in the single-word stage of language production, which found that mothers continue the topic of child topic-continuing utterances more than topic-initiating utterances (Yoder *et al.*, 1994a). Expansions are a subset of adult topic continuations. However, there are many ways to continue a topic. Additionally, it is possible that mothers in the present study could identify the topic rapidly, even after topic initiations, because many of the children in the current study initiated the topic with multiword, fully intelligible utterances. In contrast, the children in the Yoder *et al.* (1994a) study were more likely to initiate a new topic with a single-word utterance, making immediate identification of the topic less likely in the Yoder *et al.* (1994a) study than in the current study.

The results support the general premise that mothers tend to expand child utterances that have relatively many intelligible major elements more than child utterances with fewer intelligible major elements. In other words, those children with relatively longer and more intelligible utterances may tend to elicit the type of input that may help them learn more language in the future.

The present results may appear to conflict with previous literature that has shown that mothers of typically developing children tend to expand ungrammatical child utterances more than grammatical child utterances (Furrow *et al.*, 1993, for review). The authors of these studies posit that ungrammatical utterances tend to be ambiguous. These authors assume that mothers expand ambiguous utterances more than unambiguous utterances in an effort to understand them (Furrow *et al.*, 1993).

The grammaticality/ambiguity link may not be the only reason why parents expand some utterances more than others. Furrow *et al.* (1993) have shown that ungrammatical utterances tend to be more pragmatically ambiguous than do grammatical utterances. However, mothers in the Furrow *et al.* (1993) study expanded pragmatically ambiguous utterances at about the same rate as pragmatically unambiguous utterances. Additionally, if ambiguity were the primary reason why mothers expand some utterance types more than others, one would expect mothers to expand partially intelligible utterances more than fully intelligible ones, assuming that partially intelligible utterances are more ambiguous than fully intelligible utterances. The opposite pattern occurred in the present study. Future studies are needed to determine whether ill-formedness co-varies with length and intelligibility, or whether it is an independent utterance characteristic that predicts which utterances mothers expand.

Additionally, the extent to which mothers expanded single-word utterances and partially intelligible utterances was negatively related to the children's MLU. That is, mothers tended to expand single-word utterances and partially intelligible utterances more often if the children were in the early stages of language learning. This finding adds to the data supporting the notion that mothers of children with language delays also fine-tune the way they talk to their children based on their children's

productive language level (Cross, 1977). However, it should be noted that even in dyads with children whose MLU were below 2.0, all but one mother still expanded multiword and fully intelligible utterances more than they expanded single-word and partially intelligible utterances, respectively. Therefore, there is a limit to the adaptation mothers make in terms of which utterance types they expand.

Given the non-experimental research design used in the current study, we cannot be certain that increasing the intelligibility and length of children's utterances will increase maternal expansions. There is always the possibility that third, unmeasured variables account for the relationships obtained in correlational studies. For example, it is possible that transcribers are more likely to gloss a child utterance as fully intelligible more often when the following utterance is a maternal expansion than when the following utterance is not an expansion. Additionally, transactions that occur later in the interaction session may influence transcribers to return to a previous utterance and retranscribe it as fully intelligible. Doing so may result in the following maternal utterance being coded as an expansion. Either of these explanations could partly account for why it appears that mothers tend to expand fully intelligible utterances more than partially intelligible utterances. We say 'partly account for' the results, because such a transcription artifact cannot explain why only fully intelligible utterances that contained more than one word were expanded more than partially intelligible utterances.

In short, the current study identified the potential elicitors of expansions, but we need future experiments to confirm whether increasing children's fully intelligible multiword utterances increases maternal expansions. In such experiments, intelligibility and length must be manipulated through an intervention, and changes in maternal expansions must be monitored. If future experimental work confirms our hypothesis, then further research will be needed to determine the relative importance of intelligibility versus length of utterance in eliciting maternal expansions.

Nelson (1989) suggests that expansions are most likely to influence language development when the expansions model language structures that the children are developmentally ready for, and that the children have unconsciously identified as needed and missing in their present language system. In a previous study in which clinicians were trained to expand children's utterances without regard to particular language targets, it was found that expansions facilitated child MLU only in children in Brown's stages I and II (Yoder *et al.*, 1995).

Therefore, increasing the intelligibility and length of children's utterances may indirectly affect child grammatical development primarily in children who are in Brown's (1973) stages I and II. In the introduction we mentioned that children may help themselves by eliciting the type of dialogues with adults that facilitate their later language development (i.e. eliciting bootstrapping operations). The current research has identified intelligibility and length as two probable eliciting bootstrapping operations. If future experiments confirm that intelligible multiword utterances elicit maternal expansions, then one could expect that facilitating intelligibility and utterance length in children in Brown's stage I and II would result in indirect gains in grammar skills that the clinician did not target.

Finally, using existing data that were collected for other purposes by three different investigators limited our ability to describe the child participants in a detailed manner. It is possible that we have grouped children that differ in ways that affect the types of utterances mothers expand. However, whenever one conducts group-level analyses we group children that may be different on several variables.

Some of these variables may be our 'pet' variables, such as mental age or diagnosis. The relevant information is whether the children are different on variables that affect the results of the study. The state of our science does not allow us to know exactly which child variables are likely to discriminate dyads whose mothers expand utterances that are different from those investigated here. Future work is needed to determine child and maternal characteristics that affect the types of utterances mothers expand.

In summary, the current results show that mothers tended to expand child utterances that had relatively high intelligibility. Future studies are needed to determine whether increasing the intelligibility and length of children's utterances increases their subsequent grammatical development by increasing the number of maternal expansions they recruit. It was hypothesized that such may be the case for children in Brown's stages I and II. Additionally, the current results add to the data that mothers of children with language delays fine-tune their linguistic input to their children. They expand utterances with fewer intelligible elements when the children's primary productive language is in the first stages of development.

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