J. Child Lang. **32** (2005), 63–91. © 2005 Cambridge University Press
DOI: 10.1017/S0305000904006634 Printed in the United Kingdom

Maternal responsive and directive behaviours and utterances as predictors of children's lexical development*

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(*Received* 16 *January* 2003. *Revised* 22 *April* 2004)

ABSTRACT

Predictive relations were examined between measures of 20 mothers' behavioural and verbal general and specific responsiveness and intrusive and supportive directiveness and their children's subsequent expressive vocabularies during three developmental periods with endpoints at the beginning, middle, and end of the second year: 0;10 to 1;1, 1;1 to 1;5, and 1;5 to 1;9. Regression analyses, controlling for mothers' utterance frequencies and children's initial lexicons, revealed considerable consistency between reported and observed lexicons but changing patterns of predictive relations with development. During the first period, behavioural, but not verbal, measures of maternal responsiveness and supportive directiveness were positively predictive. In period two, verbal, but not behavioural, measures predicted children's vocabularies, with specific responsiveness and supportive directiveness as positive predictors and intrusive directiveness as a negative predictor. During the final period, mothers' behavioural and verbal responsiveness and

[*] This research was supported by National Institute of Child Health and Human Development grant HD37587 to the first author. The authors thank Gerald Mahoney for providing videotapes for training coders to use the Maternal Behavior Rating Scales (revised), Jennifer E. Nolten and Margaret Turner for coding, the reviewers and statistical consultants for comments and advice, and the participating children and mothers. Address for correspondence: Elise Frank Masur, Department of Psychology, Northern Illinois University, DeKalb, IL 60115, USA. e-mail: efmasur@niu.edu

behavioural supportive directiveness positively predicted and their verbal intrusive directiveness negatively predicted children's lexical growth.

INTRODUCTION

Mothers' behavioural and verbal responsiveness during dyadic interactions have frequently been shown to be positively associated with their children's subsequent competence, including language development (Bornstein & Tamis-LeMonda, 1989; Carpenter, Nagell & Tomasello, 1998; Mahoney, Boyce, Fewell, Spiker & Wheeden, 1998; Bornstein, Tamis-LeMonda & Haynes, 1999; Tamis-LeMonda, Bornstein & Baumwell, 2001). Researchers have proposed that mothers' provision of 'prompt, contingent, and appropriate (not simply contiguous)' (Bornstein & Tamis-LeMonda, 1989: 50) responsive behaviours may foster children's development by promoting their sense of security and self-efficacy (Bornstein *et al.*, 1999) and/or by enhancing their attention to and exploration of environmental stimuli (Beckwith & Cohen, 1989). Verbal responsiveness, in particular, may aid language acquisition by encouraging and reinforcing children's involvement in communicative interactions (Hoff & Naigles, 2002) and/or by providing descriptions of the environment relevant to children's immediate interests, attention, or intentions (Harris, Jones, Brookes & Grant, 1986; Tomasello & Farrar, 1986; Bloom, 1993; Hampson & Nelson, 1993; Tamis-LeMonda *et al.*, 2001; Hoff & Naigles, 2002). In light of these proposed explanations, it is surprising, then, that studies have sometimes failed to find significant positive predictive associations between certain measures of maternal responsive utterances and children's language development (e.g. Akhtar, Dunham & Dunham, 1991; Tamis-LeMonda, Bornstein, Kahana-Kalman, Baumwell & Cyphers, 1998; Tamis-LeMonda *et al.*, 2001; Hoff & Naigles, 2002).

Maternal directiveness, on the other hand, characterized by attempts to command and control children's behaviour or attention, has often been regarded as hindering children's cognitive and language performance (Marfo, 1992; Mahoney & Neville-Smith, 1996). Mothers' directiveness may be detrimental because it represents a pattern of behaviour incompatible with a beneficial responsive style (see Pine, 1992, for a review). Additionally, directive utterances which require children to redeploy their focus of attention may require greater processing and complicate the task of mapping words to situational referents (Tomasello & Farrar, 1986; Akhtar *et al.*, 1991). Yet, the findings for maternal directiveness are even more inconsistent: Mothers' directive utterances have been found sometimes to be negatively related (e.g. Tomasello & Farrar, 1986; Hampson & Nelson, 1993), sometimes positively related (e.g. Barnes, Gutfreund, Satterly &

Wells, 1983; Akhtar *et al.*, 1991), and sometimes unrelated (e.g. Tomasello & Todd, 1983; Carpenter *et al.*, 1998; Hoff & Naigles, 2002) to measures of children's language development, including vocabulary.

The present study investigates relations between mothers' responsive and directive actions and speech and their children's lexical acquisition, a primary indicator of language growth during the second year (Bornstein *et al.*, 1999). The goal is to bring coherence to a pattern of discrepant, and sometimes even contradictory, previous findings by systematically examining issues that have often varied widely in prior studies. These issues fall within three broad categories: selection of predictor and outcome variables, consideration of children's developmental levels, and inclusion of appropriate control factors.

Variable selection

As in any area of inquiry with conflicting findings, a natural candidate for explanation is divergence in variables selected for investigation. In some previous studies relating maternal attributes to children's language development, researchers have focused exclusively on responsiveness, omitting directiveness from their verbal (e.g. Tamis-LeMonda *et al.*, 1998; Bornstein *et al.*, 1999; Tamis-LeMonda *et al.*, 2001) or behavioural measures (e.g. Carpenter *et al.*, 1998). In other instances, investigators have analysed only mothers' speech (e.g. Akhtar *et al.*, 1991; Tamis-LeMonda *et al.*, 2001; Hoff & Naigles, 2002) or their behaviour (e.g. Mahoney *et al.*, 1998), rather than both. Occasionally researchers have employed responsiveness scores combining mothers' speech and behaviour together (e.g. Tomasello & Todd, 1983) or integrating mothers' and infants' behaviours into dyadic measures, such as joint engagement (e.g. Carpenter *et al.*, 1998). But no study to our knowledge has so far distinguished and considered both behavioural and verbal measures of mothers' responsiveness and directiveness within the same sample. In this study, we investigated whether both mothers' responsiveness and directiveness predict their children's vocabulary growth. And we particularly examined the extent to which directive behaviours and utterances contribute incrementally, above and beyond measures of responsive behaviours and speech, to predictions of children's lexical development.

Diversity in measures of mothers' responsive and directive speech has also characterized the research literature. Because it has been suggested that responsive utterances that describe objects, activities, or events to which children are currently attending may assist them in mapping words to environmental referents (Akhtar *et al.*, 1991; Hampson & Nelson, 1993; Tamis-LeMonda *et al.*, 2001; Hoff & Naigles, 2002), several studies have included maternal descriptions or a similar measure. But even so,

differences remain. Tamis-LeMonda *et al.* (2001) counted descriptions contingent upon any child act, but Hoff & Naigles (2002) considered only those responding to child speech and then combined them with other kinds of topic-continuing replies. In this study, we have followed Tamis-LeMonda *et al.* (2001) in not restricting descriptive utterances to those serving as replies to child speech, a criterion potentially influenced by children's productivity. And because we agree with Akhtar *et al.* (1991) and Tomasello & Farrar (1986) that the child's attentional focus may be important in facilitating a match between word and world, we have examined only those descriptions which follow into children's ongoing activity, responding and making reference to aspects of the environment children are currently attending to or engaged with (FOLLOW DESCRIPTIONS). Furthermore, in keeping with Tamis-LeMonda *et al.* (2001), we also included a more specific and stringent verbal measure – imitation. In parallel in the behavioural domain, we added action imitation to our general measure of rated behavioural responsiveness.

Although fewer studies examine verbal directiveness than responsiveness, variation in measures selected is evident there, too. For example, although Pine (1992) argued for separating attentional from behavioural directives, Hoff & Naigles (2002: 425) scored mothers' 'behavior directives,' a class encompassing utterances that 'directed either the child's attention or behavior.' They found no association between mothers' provision of this combined measure of attentional and behavioural directives and children's subsequent lexicons. Although Akhtar *et al.* (1991) did not at first distinguish between attentional and behavioural directives, they did differentiate between directives which followed and those which led the children's focus of attention. They reported that mothers' production of directives which followed into their children's attentional focus (e.g. *Put the block in here* or *Look at this hole* when the child is holding and/or looking at the block or shapesorter) was positively associated with children's later vocabularies. In contrast, a subcategory of lead directives which redirected children's attention (e.g. *Watch this*, when the child is looking at something else) negatively predicted later lexicons. In light of Pine's argument and Akhtar *et al.*'s findings, we have distinguished attentional from behavioural and leading from following directives and focused on attentional directives which lead (LEAD ATTENTIONAL DIRECTIVES) and behavioural directives which follow (FOLLOW BEHAVIOURAL DIRECTIVES) a child's focus of attention. Furthermore, we have incorporated this distinction in the verbal domain between more intrusive directives that may disrupt a child's ongoing activity and more supportive directives that attempt to follow and extend the child's current activity into the behavioural domain also, contrasting a behavioural measure of more intrusive directiveness (Mahoney's [1992] Directiveness rating) with a measure of more supportive directiveness

(Mahoney's [1992] Achievement Orientation rating). In both domains, intrusive directiveness was expected to be a negative predictor and supportive directiveness a positive predictor of children's lexical acquisition.

Researchers differ in their choice of dependent measures as well, even among those who measure lexical production as an outcome. For instance, Akhtar *et al.* (1991) and Tamis-LeMonda *et al.* (2001) relied on two different maternal report measures, while Bornstein *et al.* (1999) and Hoff & Naigles (2002) counted children's observed vocabularies in divergent ways. Although the original debate over the merits of reported versus observed vocabularies arose over disparity in the proportions of nouns they typically yield, not from discrepancies in total lexicon estimates (Bloom, Tinker & Margulis, 1993; Pine, Lieven & Rowland, 1996; Masur & Eichorst, 2002), the controversy continues. In fact, Hoff & Naigles (2002) suggested the association between maternal responsiveness and children's reported vocabularies might be merely an artifact of greater awareness of their children's word knowledge on the part of more responsive mothers, although many studies report high correlations between reported and observed vocabulary sizes (e.g. Tomasello & Todd, 1983; Bates, Bretherton & Snyder, 1988; Masur & Eichorst, 2002). To contribute to clarifying this issue, we have employed both maternal report and observational measures of the children's lexicons as well as a combined measure of total vocabulary as outcome variables. We expected all measures to yield comparable results.

Developmental considerations

An often overlooked candidate for explicating discrepancies among studies is developmental level. Because children's capacities are evolving, maternal characteristics irrelevant at one age might facilitate growth at another. For example, Tamis-LeMonda *et al.* (2001) found mothers' provision of vocal/verbal imitation to children at 0;9 was unrelated to their lexical growth, while the same behaviour to children at 1;1 – a time of transition to first words – predicted their acquisition of 50-word vocabularies. However, mothers' provision of utterances describing the environment to children at 1;1 was not associated with children's language competence at the end of the second year (Akhtar *et al.*, 1991; Tamis-LeMonda *et al.*, 2001). But whether maternal descriptive utterances provided in the middle of the second year, when many children are rapidly acquiring new words, would predict children's lexicons at the end of the year is unknown. No previous study has specifically examined this period, and few have investigated more than one time interval. Hoff & Naigles (2002), who did include some children aged 1;6, combined them in a large group with children as old as 2;5, preventing separate analysis of this particular developmental period. The present study analyses predictive relations for three time intervals

whose endpoints at the beginning, middle, and end of the second year were chosen to correspond to the times children typically reach language benchmarks of early words, a vocabulary spurt, and rudimentary two-word utterances. We expected different predictive relations for each interval.

Statistical controls

Finally, some of the inconsistencies in previous research findings may be attributable to the presence or absence of certain statistical controls. Some studies associating mothers' responsive utterances at an earlier time with their children's lexical development later on adjust for the children's initial lexical levels (e.g. Bornstein *et al.* 1999; Hoff & Naigles, 2002), while others do not (e.g. Akhtar *et al.*, 1991; Carpenter *et al.*, 1998; Tamis-LeMonda *et al.*, 2001). The diversity among these studies in variables selected or developmental period examined makes it is impossible to determine whether this methodological choice made a difference. But because controlling for the size of children's earlier lexicons would seem to be an obvious and prudent practice, we have adopted it for all our predictive analyses.

Another statistical issue concerns controls for mothers' utterance frequencies. Because children's language growth has been related to greater overall maternal input (Akhtar *et al.*, 1991; Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991), some researchers have adjusted for the amount of mothers' speech in calculating some (e.g. Akhtar *et al.*, 1991; Hampson & Nelson, 1993) or all (e.g. Bornstein *et al.*, 1999; Hoff & Naigles, 2002) predictive relations; but others have not (e.g. Carpenter *et al.*, 1998; Tamis-LeMonda *et al.*, 2001). Variation in mothers' utterance frequencies might actually contribute to some of the reported relations between mothers' speech characteristics and children's lexicons. For example, Akhtar *et al.* (1991) found that the negative relation between mothers' provision of intrusive attention-directing utterances and their children's vocabularies failed to hold when the numbers of mothers' utterances per minute were taken into account. For this reason, we have tested all predictive relations with maternal utterance frequencies also controlled.

The present study

This investigation is the first to examine at the same time the predictive relations from mothers' responsive and directive behaviours and utterances to their children's subsequent observed, reported, and total productive vocabularies. In addition, it is the first to apply appropriate statistical controls for mothers' utterance frequencies and for children's initial vocabularies in all predictive analyses. The mothers' speech and actions were observed in dyadic interactions during naturalistic play and caretaking

situations in participants' homes with children at 3 ages chosen to represent normative language milestones: at 0;10 when communicative gestures develop; at 1;1 when first words emerge; and at 1;5, a period of vocabulary spurt for many children (Masur, 1983; Goldfield & Reznick, 1990). Children's lexicons were evaluated at 1;1, at 1;5, and at 1;9 when many children begin to produce two-word utterances (Nelson, 1973).

Mothers' behavioural and verbal responsiveness was assessed with both general and more specific measures. The general measures included ratings of their behaviour and frequencies of their following descriptive utterances; the specific measures consisted of action and verbal imitation. Maternal behavioural and verbal directiveness measures were chosen to represent both more intrusive and more supportive tendencies. The more intrusive included rated directiveness and frequencies of attention-leading directive utterances, while the more supportive consisted of ratings of achievement orientation and frequencies of behavioural directives which follow children's attentional focus. We hypothesized that both maternal responsive and maternal directive measures would be related to children's later lexical levels. For both behavioural and verbal measures, we expected that responsiveness and supportive directiveness would positively predict while intrusive directiveness would negatively predict children's later lexicons.

METHOD

Participants

Participants included 10 girls and 10 boys and their mothers who had been recruited for a naturalistic, longitudinal study of 'infants' reactions to the people and objects in their environment' through letters sent in response to newspaper birth announcements. The families lived in small towns, suburbs, and rural areas surrounding a university town in Illinois, USA; the parents were native English speakers. The children, who were physically normal and appeared healthy, included 12 firstborns (6 boys and 6 girls); 19 dyads were European-American, and one was African-American. As part of a more extensive research project, the dyads were visited in their homes when infants were 0;10 (M=0;10.14), 1;1 (M=1;1.15), 1;5 (M=1;5.19), and 1;9 (M=1;9.18); a second visit at each age, not analysed here, occurred about one week later. Seventeen of the dyads participated at all 4 ages, while 3 (2 girls and 1 boy) joined the study at 1;1 to replace others who had discontinued or moved away.

Procedure

Dyads were videotaped for about 15 min in baththime (M=13·78 min, $S.D.$=1·80) and free play (M=14·14 min, $S.D.$=1·97), and in a third

situation not analysed here, by female researchers who were nonintrusive and as unobtrusive as possible. Session order, with bathtime either first or third and free play either first or second, was counterbalanced across children. During bathtime, the mothers were asked to bathe their children the way they usually did. During free play, mothers were asked to play with their children and the toys as if they had 10 to 15 min of free time. The same free play and bath toys were provided at each age. At the end of the first visit at each age, mothers were interviewed about their children's language development and other behaviour for approximately 45 to 60 min with the Words, Sounds, and Actions Checklist, described below.

Measures and coding

All maternal measures were coded from the videotapes of the sessions or from transcripts made from them. The transcripts, prepared by observers working in pairs, recorded all vocalizations, words, and actions of both children and mothers. Both members of a pair had to agree before behaviours were recorded on the transcripts.

Mothers' behaviour ratings. Maternal behaviour was measured with the Maternal Behavior Rating Scale (revised; MBRS; Mahoney, 1992) which provides global ratings of 12 aspects of mothers' behaviour, rated on 5-point scales, chosen for their empirical relations to children's development (Mahoney & Powell, 1988; Mahoney *et al.*, 1998). The MBRS has been employed to rate behaviour in children with diverse characteristics, including those at risk, developmentally delayed, low birth weight, and normal (Mahoney *et al.*, 1998). Ratings using the scale have demonstrated reliability (Mahoney *et al.*, 1998); and the 4 scale scores which Mahoney and colleagues derived through factor analysis – Responsiveness, Directiveness, Affect, and Achievement Orientation – have demonstrated convergent validity with other frequency and rating measures of maternal characteristics (Boyce, Marfo, Mahoney, Spiker, Price & Taylor, 1996; Mahoney *et al.*, 1998).

This study utilized three of the scale scores–Responsiveness, Directiveness, and Achievement Orientation (Mahoney, 1992). Responsiveness was the mean of ratings of Sensitivity to child's interest ('… extent to which the parent seems aware of and understands the child's activity or play interests.'), Responsivity ('… appropriateness of the parent's responses to the child's behaviors …'), and Effectiveness ('… parent's ability to engage the child in the play interaction'; Mahoney, 1992). The Directiveness score, chosen to measure intrusive directiveness, was the mean of ratings on Directiveness ('… the frequency and intensity in [sic] which the parent requests, commands, hints, or attempts in other manners [sic] to direct the child's immediate behavior') and Pace ('… the parent's rate of behavior';

Mahoney, 1992). The third score, Achievement Orientation, chosen to measure supportive directiveness, was the mean of ratings on Achievement orientation ('... extent to which the parent fosters sensorimotor and cognitive development whether through play, instruction, training, or sensory stimulation and includes the energy which the parent exerts in striving to encourage the child's development.') and Praise (verbal) ('Praise may be given for compliance, achievement or for the child being himself'; Mahoney, 1992). Mothers' separate scores in bath and play contexts were summed to yield total scores for Responsiveness, Directiveness, and Achievement Orientation at each age.

After careful training on tapes provided by Gerald Mahoney, two observers viewed and rated mothers in the 154 bath and play sessions, in a random order, on all 12 items of the MBRS, with a few slight modifications in wording to some of the scale-point definitions (available on request). To allow for participants' adjustment to the sessions, observers watched the videotapes from the beginning of the 3rd min until the beginning of the 11th min, except in the cases of 11 sessions which ended slightly early ($M = 76$ sec). Inter-rater reliability on the 7 ratings used in this study were computed on 16 videotapes, equally divided by child sex and by bath or play context, which were independently scored by the two observers. Eighty-eight percent of ratings of Directiveness, 88% of ratings of Praise, and 100% of ratings of all the other 5 items were within the 1-point range accepted by this and similar scales as in agreement (e.g. Crawley & Spiker, 1983; Mahoney & Powell, 1988); differences were resolved through discussion. Cohen's kappas, calculated with ratings within the 1-point range accepted by the scale considered to be in agreement, were 0·79 for Directiveness, 0·77 for Praise, and 1·00 for each of the 5 other ratings.

Pragmatic categories of mothers utterances. All maternal utterances produced within the same 8-min period considered for maternal behaviour ratings, from the beginning of the 3rd to the beginning of the 11th min, were identified on the transcripts of all bath and play sessions and categorized for pragmatic function. Utterance boundaries were determined by intonation contours and pauses in speech. False starts, unintelligible utterances, and those which did not fall entirely within the 8-min period were excluded. The total number of utterances each mother produced was also tallied. Utterances were classified into one of 5 categories, based on the system developed by Pine (1992), in terms of their pragmatic function, regardless of syntactic form. Three categories were utilized in the present analyses: (1) Descriptions, including comments about actions, feelings, objects, or attributes of the child or of objects available in the immediate environment (e.g. *Is it a blue block? You like the bunny. You're putting them in.*); (2) Attentional Directives, including vocatives, which seek to attract, direct, or redirect the child's attention (e.g. *Look here. See the bunny?*); and

(3) Behavioural Directives, which seek to influence the physical behaviour of the child by commanding requesting, suggesting, or encouraging the child to do or to cease doing something (e.g. *Get the ball. The square one should go here.*).

Utterances were also coded for their attentional focus as Follow or Lead. Follow utterances, similar to the 'current' utterances of Harris, Jones & Grant (1983: 24), made reference to an object, action, or attribute to which the child was visually attending or with which the child was engaged (e.g. holding, manipulating) at the onset of utterance. All utterances not qualifying as Follow were classified as Lead. The analyses reported here utilized the following pragmatic category scores which were computed from mothers' utterance frequencies for play and bath sessions (prorated for the 11 sessions which were slightly shorter than 8 min) and summed across sessions: Follow Descriptions, chosen as a measure of informative verbal responsiveness; Lead Attentional Directives, chosen as a measure of intrusive directiveness; and Follow Behavioural Directives, chosen as a measure of supportive directiveness.

Reliability determination and coding for the 154 bath and play sessions took place in two parts. Interactions when the infants were aged 1;1 and 1;9 were coded first. A primary coder and an assistant first established inter-rater agreement in classifying maternal utterances on transcripts for interactions at those ages. Cohen's kappas, calculated on 16 randomly chosen independently coded transcripts – 2 dyads with girls and 2 dyads with boys at each age in each context – averaged 0·85 for pragmatic categories and 0·83 for attentional focus. Disagreements were resolved through discussion; then the remaining transcripts at those ages were coded.

Reliability determination and coding of maternal utterances to the infants at 0;10 and 1;5 were conducted by the primary coder and a different assistant more than a year later. To establish continuity and reliability with the earlier coding process, the primary coder recoded maternal utterances on 8 randomly chosen transcripts at 1;1 and 1;9, one for a dyad with a boy and one with a girl in each context at each age; Cohen's kappas on each transcript averaged 0·90 for pragmatic categories and 0·89 for attentional focus. Then the primary coder and the second assistant established reliability and coded maternal utterances to the infants at 0;10 and 1;5. Cohen's kappas computed on 16 independently coded transcripts, 2 for dyads with girls and 2 for dyads with boys at each age and in each context averaged 0·85 for pragmatic categories and 0·84 for attentional focus; disagreements were resolved through discussion.

Mothers' action and verbal imitation scores. The mothers' scores for object-related action and verbal imitation utilized in these analyses were derived from records of episodes of spontaneous vocal, verbal, and action imitation by both mothers and infants that had been identified and coded

from videotapes and transcripts of the entire bathtime and free play sessions (see Masur & Rodemaker, 1999, for a complete report on defining, identifying, and coding spontaneous imitation).

While viewing the videotapes, coders marked on the transcripts all episodes of discrete non-facial imitation by either partner which met criteria, originally developed by Masur (1987), of attention ('The imitator saw (or heard) the partner.' Masur & Rodemaker, 1999), contingency ('The imitator's behavior was evoked by the partner's behavior …' Masur & Rodemaker, 1999), and similarity ('The imitation was an exact copy or close approximation of the partner's vocal or action behavior.' Masur & Rodemaker, 1999). Each imitation episode began with the modelled sound or act and ended with the last repetition of that behaviour by either partner. Interobserver agreement between a primary coder and each of 3 assistants on 2 videotapes at each age and in each context in identifying episodes in which the mother was the first imitator, calculated as the number of episodes identified by both divided by the number of episodes identified by either, was 96%, 86%, and 95%, respectively; all disagreements were resolved through reviewing and discussing the videotapes.

Episodes were then classified as actions on objects, actions without objects, vocalizations, or verbalizations, a category including conventional words and phrases (e.g. *ball*, *thank you*) and conventionally meaningful vocalizations (e.g. *uh-oh*, *quack-quack*). Cohen's kappas for interrater agreement on the same videotapes between the primary coder and each of the three assistants in classifying the mothers' identified imitation episodes were 1·00, 0·95, and 0·96; disagreements were resolved through discussion. Frequencies of episodes of mothers' imitations of actions on objects and verbalizations, adjusted for the length of time of the sessions, were summed across bath and play time to yield scores for maternal action and verbal imitation at each age. Verbal imitation at 0;10, however, was too infrequent to be included in the analyses.

Children's lexicons. Three measures of expressive vocabulary were employed in these analyses: reported vocabulary, observed vocabulary, and total vocabulary, which encompassed the reported lexicon plus all items in the observed lexicon which had not been reported. Reported vocabulary was derived from the maternal interview with the Words, Sounds and Actions Checklist. The Checklist, which also included nonverbal vocal and motoric behaviours and some two-word semantic relations, was adapted from the Language Comprehension and Production Interview by Bates, Bretherton & Snyder (1982). Interview measures developed by Bates and colleagues, and ones adapted from them, have consistently reported high concurrent and predictive relations with observed lexicons or other language measures (Bates *et al*., 1988; Hampson & Nelson, 1993). Masur & Eichorst (2002) found that children's vocabulary totals on the Checklist

were very close to those reported by others for children at the same or similar ages (Nelson, 1973; Snyder, Bates & Bretherton, 1981; Olson, Bayles & Bates, 1986; Pine, 1992).

The Checklist consisted of lexical items within three general domains: proper names (excluded from analyses because Snyder *et al.*, 1981, found them unrelated and Olson *et al.*, 1986, found them negatively related to total lexicons); common nouns; and diverse other non-nouns. The common nouns included the categories of food, clothing, household items, body parts, toys and vehicles, and animal names. The non-nouns encompassed five heterogeneous categories: actions and requests; personal-social words and conventional vocalizations; modifiers; activities, games, and animal noises; and pronouns and functors. Besides the items listed on the Checklist, in accord with a procedure advocated by Pine *et al.* (1996) to obtain the most complete record possible of the children's lexicons, mothers were also requested to name any other words in each category produced by their children. Only words reported by the mothers as spontaneously produced were counted.

To determine children's observed lexicons, all conventional words and conventionally meaningful vocalizations produced by the children during the entire bathtime and free play sessions were identified on the transcripts of the videotaped sessions and marked on an expanded version of the Checklist using the same categories described above. To ensure the transcripts had not omitted any words or conventional vocalizations, the third author, a graduate student in developmental psychology and in the certification programme in speech/language pathology, reexamined transcripts while viewing the videotapes. The few instances of disagreement with the prepared transcripts were resolved through discussions with the first author according to the conservative policy of granting credit for a production only in unequivocal cases.

Analyses

Analyses involving measures when the children were 0;10 employed data from 17 mothers and children, while those involving measures at 1;1, 1;5, and 1;9 employed the total sample of 20 dyads. Two-tailed tests of significance are reported for all analyses. For the hierarchical regression analyses assessing the predictive power of responsiveness and directiveness measures separately, the control factors of children's earlier lexical levels and maternal utterance frequencies were entered as a block first. Then stepwise procedures were applied to select parsimoniously the responsiveness or directiveness measures to be included in the predictive equations, with the p-value to enter set at 0·10 to provide a comprehensive picture of significant findings and trends. For the final set of regressions evaluating the predictive

power of directiveness above and beyond responsiveness, control factors were entered as a block first, followed by responsiveness measure(s) with significant final beta weights in a block. The significant directiveness factor(s) were then entered as a final block. Diagnostic statistics were examined for all regression analyses to check for the presence of multicollinearity. All regression analyses were judged acceptable since all Condition Index values were under 30, less than the most stringent limit advocated by Belsley, Kuh & Welsch (1980).

RESULTS

The results are presented in two parts. The first part provides descriptive statistics for the maternal predictive variables at 0;10, 1;1 and 1;5 and for the outcome variables of children's total, reported, and observed expressive vocabularies at 1;1, 1;5, and 1;9. The maternal variables include general and specific behavioural and verbal responsiveness measures and intrusive and supportive behavioural and verbal directiveness measures; correlations between these measures and maternal utterance frequencies are also presented. In addition, relations between mothers' behavioural and verbal measures of responsiveness and directiveness at 0;10, 1;1, and 1;5, controlling for maternal utterance frequencies, and their children's concurrent lexical production are provided. In the second part, the predictive relations between these maternal measures and their children's subsequent lexical development for each developmental interval – 0;10 to 1;1, 1;1 to 1;5, and 1;5 to 1;9 – are assessed with regression analyses (see Analysis section, above).

Descriptive statistics

Relations between maternal measures and maternal utterance frequencies. Descriptive statistics for mothers' predictive behavioural and verbal responsiveness and directiveness measures and for children's total, reported, and observed expressive vocabulary outcome measures are presented in Tables 1 and 2, respectively. In addition, Table 1 shows that many behavioural and verbal measures of maternal responsiveness and directiveness evidenced strong links to mothers' utterance frequencies, justifying our concern for statistical control of maternal production. Both measures of general responsiveness – responsiveness rating and follow descriptions – were significantly correlated with frequencies of maternal utterances at each age ($r \geqslant 0{\cdot}56$, $p < 0{\cdot}01$), while both measures of specific responsiveness – action and verbal imitation – were related to maternal utterance frequencies at 1;5 ($r \geqslant 0{\cdot}44$, $p \leqslant 0{\cdot}05$). There were associations between mothers' directiveness and their utterance frequencies as well. Both behavioural and verbal

TABLE 1. *Means (and standard deviations) for maternal predictive measures and their relations to maternal utterance frequencies*

	Time of measurement								
	0;10			1;1			1;5		
Maternal measure	*M*	(*S.D.*)	r^a	*M*	(*S.D.*)	r^a	*M*	(*S.D.*)	r^a
Responsiveness–general									
Responsiveness rating	6·41	(0·93)	0·70**	6·17	(0·81)	0·56*	6·58	(0·86)	0·62**
Follow descriptions	42·88	(26·25)	0·66**	44·35	(28·29)	0·65**	48·70	(28·82)	0·87***
Responsiveness–Specific									
Action imitation	2·42	(2·54)	0·04	2·81	(1·53)	0·10	3·19	(2·08)	0·44*
Verbal imitation	–[b]	–	–	1·72	(1·97)	0·30	13·70	(16·77)	0·53*
Directiveness–intrusive									
Directiveness rating	5·76	(0·73)	0·26	5·70	(0·96)	0·69***	5·72	(0·85)	0·66**
Lead attentional directives	18·41	(9·26)	0·33	18·20	(10·66)	0·50*	16·30	(11·54)	−0·01
Directiveness–supportive									
Achievement orientation rating	3·88	(0·74)	0·56*	4·52	(0·88)	0·59**	4·25	(1·09)	0·49*
Follow behavioural directives	23·18	(14·21)	0·56*	25·50	(13·14)	0·73***	29·50	(14·32)	0·76***

[a] Correlation with maternal utterance frequencies. [b] Verbal imitation was too infrequent at 0;10 to be included.
* $p \leqslant 0{\cdot}05$, ** $p < 0{\cdot}01$, *** $p < 0{\cdot}001$.

TABLE 2. *Means, standard deviations, and ranges of children's total, reported and observed lexicons at outcome times of measurement*

	Time of measurement								
	1;1			1;5			1;9		
Measure	*M*	*S.D.*	Range	*M*	*S.D.*	Range	*M*	*S.D.*	Range
Children's total lexicons	13·50	10·04	0–38	56·25	46·51	3–174	121·85	61·48	29–246
Children's reported lexicons	12·60	10·07	0–38	52·10	43·51	2–165	109·30	54·16	23–219
Children's observed lexicons	1·75	1·80	0–6	11·05	9·90	0–33	28·95	18·66	3–62

measures of supportive directiveness – achievement orientation rating and follow behavioural directives – were positively related to utterance frequencies at every age ($r \geqslant 0{\cdot}49$ $p < 0{\cdot}05$). Even behavioural and verbal measures of maternal intrusive directiveness were positively linked to utterance frequencies – directiveness ratings at 1;1 and 1;5 and lead attentional directives at 1;1 ($r \geqslant 0{\cdot}50$, $p < 0{\cdot}05$). Because of these consistent associations, all subsequent analyses control for maternal utterance frequencies.

Mothers' responsiveness and directiveness and their children's concurrent lexicons. Partial correlations controlling for maternal utterance frequencies between measures of mothers' behavioural and verbal responsiveness and directiveness at 0;10, 1;1, and 1;5 and their children's concurrent lexicons yielded several significant associations in the expected directions (see Table 3). Although no measure of general responsiveness was related to children's concurrent vocabularies, mothers' specific verbal responsiveness demonstrated significant associations to all lexicons at 1;1 and 1;5 ($r \geqslant 0{\cdot}62$, $p < 0{\cdot}01$). Among directiveness measures, lead attentional directives exhibited expected negative associations to all three indices of children's concurrent vocabularies at 1;5 ($r \leqslant -0{\cdot}58$, $p < 0{\cdot}01$), while directiveness ratings showed an unexpected positive relation to children's observed lexicons at 0;10 ($r = 0{\cdot}55$, $p < 0{\cdot}05$). These associations lent support to our decision to control for children's earlier lexicons in all predictive analyses.

Mothers' responsiveness and directiveness and their children's subsequent lexicons

Three kinds of hierarchical regression analyses (see Analyses section, above) assessed predictive relations from mothers' behavioural and verbal scores to their children's subsequent total, reported, and observed expressive

TABLE 3. *Partial correlations between maternal predictive measures and children's concurrent vocabularies, controlling for maternal utterance frequencies*

Maternal measure	Children's vocabulary		
	Total	Reported	Observed
		At 0;10	
Responsiveness–general			
Responsiveness rating	0·06	0·09	−0·25
Follow descriptions	−0·05	−0·05	−0·00
Responsiveness–specific			
Action imitation	0·33	0·29	0·28
Verbal imitation	–	–	–
Directiveness–intrusive			
Directiveness rating	0·14	0·08	0·55*
Lead attentional dir.	−0·11	−0·06	−0·35
Directiveness–supportive			
Achievement or. rating	−0·10	−0·10	−0·04
Follow behavioural dir.	0·10	0·15	−0·44
		At 1;1	
Responsiveness–general			
Responsiveness rating	−0·22	−0·25	0·14
Follow descriptions	−0·09	−0·12	0·18
Responsiveness–specific			
Action imitation	−0·14	−0·13	−0·13
Verbal imitation	0·68**	0·62**	0·85***
Directiveness–intrusive			
Directiveness rating	−0·21	−0·20	−0·28
Lead attentional dir.	−0·04	0·01	−0·31
Directiveness–supportive			
Achievement or. rating	−0·21	−0·21	−0·04
Follow behavioural dir.	0·41	0·42	0·23
		At 1;5	
Responsiveness–general			
Responsiveness rating	0·08	0·07	0·20
Follow descriptions	0·21	0·19	0·31
Responsiveness–specific			
Action imitation	0·12	0·13	0·21
Verbal imitation	0·85***	0·84***	0·89***
Directiveness–intrusive			
Directiveness rating	−0·20	−0·20	−0·21
Lead attentional dir.	−0·59**	−0·58**	−0·66**
Directiveness–supportive			
Achievement or. rating	−0·30	−0·32	−0·16
Follow behavioural dir.	0·25	0·26	0·13

* $p < 0{\cdot}05$, ** $p \leqslant 0{\cdot}01$, *** $p \leqslant 0{\cdot}001$.

vocabulary levels for each of the three time intervals – 0;1 to 1;1, 1;1 to 1;5, and 1;5 to 1;9 – after mothers' earlier utterance frequencies and children's earlier levels of the respective vocabulary measures had been entered as control factors. The first determined whether any of the maternal general

https://doi.org/10.1017/S0305000904006634 Published online by Cambridge University Press

and specific behavioural and verbal responsiveness measures predicted children's vocabularies. The second separately tested whether any of the mothers' intrusive or supportive behavioural and verbal directiveness scores predicted their children's lexicons. Finally, in cases where both responsiveness and directiveness analyses had yielded significant findings, further analyses ascertained whether mothers' directiveness contributed additionally, beyond the significant responsiveness measures, to the predictions. The analyses revealed changing patterns of predictive relations with development.

Predictors of children's lexicons at 1;1. Analyses for the first time interval, from mothers' scores at 0;10 to children's vocabularies at 1;1, found significant positive predictive relations for behavioural, but not verbal, measures of maternal responsiveness and supportive directiveness (see Table 4).

Maternal responsiveness at 0;10 predicted children's total and reported lexicons at 1;1, although children's observed lexicons were too restricted to yield results. The control factors contributed significantly to the predictions for both total ($^{\Delta}R^2 = 0{\cdot}56$, $p < 0{\cdot}01$) and reported lexicons ($^{\Delta}R^2 = 0{\cdot}58$, $p < 0{\cdot}01$). Stepwise procedures revealed that mothers' behavioural responsiveness ratings made an additional significant contribution to the prediction for total lexicons ($^{\Delta}R^2 = 0{\cdot}13$, $p < 0{\cdot}05$; final equation $F[3, 16] = 9{\cdot}61$, $p = 0{\cdot}001$; adjusted $R^2 = 0{\cdot}62$) and showed a trend for reported lexicons ($^{\Delta}R^2 = 0{\cdot}10$, $p < 0{\cdot}07$; final equation $F[3, 16] = 9{\cdot}02$, $p < 0{\cdot}01$; adjusted $R^2 = 0.60$). The beta weights for mothers' responsiveness ratings in the final equations similarly demonstrated a significant independent contribution to prediction of children's total lexicons ($\beta = 0{\cdot}50$, $p < 0{\cdot}05$) and showed a trend for children's reported lexicons ($\beta = 0{\cdot}44$, $p < 0{\cdot}07$). Each control factor also made a significant independent contribution to the predictions when all other factors were controlled. Children's prior lexicons were positively predictive of total (final $\beta = 0{\cdot}71$, $p < 0{\cdot}001$) and reported lexicons (final $\beta = 0{\cdot}69$, $p < 0{\cdot}001$). However, mothers' earlier utterance frequencies, despite non-significant zero-order correlations, were found to be negatively predictive of total (final $\beta = -0{\cdot}54$, $p < 0{\cdot}05$) and reported lexicons (final $\beta = -0{\cdot}52$, $p < 0{\cdot}05$) when all other measures were controlled.

Maternal directiveness at 0;10 also significantly predicted children's total and reported vocabularies at 1;1. After the control factors had been entered, the behavioural measure of mothers' supportive directiveness, achievement orientation rating, was an additional significant positive predictor for both total ($^{\Delta}R^2 = 0{\cdot}21$, $p < 0{\cdot}01$) and reported vocabularies, ($^{\Delta}R^2 = 0{\cdot}18$, $p < 0{\cdot}01$). In the final equations predicting total and reported vocabularies, children's earlier lexical levels and mothers' achievement orientation ratings were positive predictors (final $\beta \geqslant 0{\cdot}52$, $p < 0{\cdot}01$) and mothers' earlier utterance frequencies was again a negative predictor (final $\beta \leqslant -0{\cdot}50$, $p < 0{\cdot}01$; final equation $F[3, 16] \geqslant 13{\cdot}54$, $p < 0{\cdot}001$; adjusted $R^2 \geqslant 0{\cdot}70$).

TABLE 4. *Hierarchical regressions predicting children's lexicons at* 1;1 *from maternal responsiveness and directiveness measures at* 0;10

	Total lexicons at 1;1				Reported lexicons at 1;1				Observed lexicons at 1;1			
Predictors	*F*(equation)	*Adj.* R^2	ΔR^2	Final β	*F*(equation)	*Adj.* R^2	ΔR^2	Final β	*F*(equation)	*Adj.* R^2	ΔR^2	Final β
Maternal responsiveness at 0;10	9·61***	0·62			9·02**	0·60			2·39	0·15		
Control factors:			0·56**				0·58**				0·25	
Children's lexicons				0·71***				0·69***				0·10
Mothers' utterance frequencies				−0·54*				−0·52*				0·44
Responsiveness measures in the equation:												
Responsiveness rating			0·13*	0·50*			0·10[a]	0·44[a]				
Maternal directiveness at 0;10	14·97***	0·72			13·54***	0·70			2·39	0·15		
Control factors:			0·56**				0·58**				0·25	
Children's lexicons				0·78***				0·76***				0·10
Mothers' utterance frequencies				−0·51**				−0·50**				0·44
Directiveness measures in the equation:												
Achievement orientation rating			0·21**	0·56**			0·18**	0·52**				
Maternal responsiveness and directiveness at 0;10	14·22***	0·77										
Control factors:			0·56**									
Children's lexicons				0·76***								
Mothers' utterance frequencies				−0·69**								
Responsiveness predictor:			0·13*									
Responsiveness rating				0·33[a]								
Directiveness predictor:			0·14**									
Achievement orientation rating				0·47**								

[a] $p \leqslant 0{\cdot}10$, * $p \leqslant 0{\cdot}05$, ** $p \leqslant 0{\cdot}01$, *** $p \leqslant 0{\cdot}001$.

The final analysis for this developmental interval assessed whether maternal directiveness at 0;10 contributed independently to the predictions of children's lexicons at 1;1, above and beyond the control and significant responsiveness measures. This analysis was conducted only for total lexicons because maternal responsiveness ratings made a significant predictive contribution only to the regression for that outcome measure. The analysis revealed that even after the inclusion of the control factors and maternal responsiveness ratings, the measure of mothers' supportive behavioural directiveness, achievement orientation rating, made a further contribution to the prediction of children's total lexicons at 1;1 ($^{\Delta}R^2 = 0{\cdot}14$, $p = 0{\cdot}01$; final equation $F[4, 15] = 14{\cdot}22$, $p < 0{\cdot}001$). The control factors and predictors together accounted for 77% of the variance in children's total lexicons.

Predictors of children's lexicons at 1;5. In the period from 1;1 to 1;5, responsive and directive characteristics of mothers' speech, but not their interactive behaviours, predicted all three measures of children's language growth (see Table 5).

The analysis of maternal responsiveness predictors at 1;1 found that even with the significant contributions of children's vocabularies and mothers' utterance frequencies at 1;1 controlled ($^{\Delta}R^2 \geqslant 0{\cdot}35$, $p < 0{\cdot}05$), mothers' verbal imitation at the beginning of the second year accounted for an additional 43% to 47% of the variance in children's total and reported lexicons at the middle of the second year ($^{\Delta}R^2 \geqslant 0{\cdot}43$, $p < 0{\cdot}0001$; final equation $F[3, 16] \geqslant 23{\cdot}31$, $p < 0{\cdot}0001$). For observed lexicons, in addition to the significant contribution of verbal imitation ($^{\Delta}R^2 = 0{\cdot}25$, $p = 0{\cdot}001$), mothers' follow descriptions also showed a trend ($^{\Delta}R^2 = 0{\cdot}04$, $p < 0{\cdot}08$; final equation $F[4, 15] = 16{\cdot}12$, $p < 0{\cdot}0001$). Control factors and responsiveness predictors together accounted for 76% to 79% of the variance in the three vocabulary measures. Examination of final beta weights in all three equations, however, revealed the strength of mothers' verbal imitation, which was the only significant independent predictor (final $\beta \geqslant 0{\cdot}91$, $p < 0{\cdot}001$).

Maternal directiveness at 1;1 also significantly predicted children's vocabularies at 1;5, with control factors and predictors together accounting for 45% to 67% of the variance in all three lexical measures. With control factors adjusted, stepwise procedures found mothers' provision of lead attentional directives, a measure of verbal intrusiveness, was an additional significant negative predictor for children's total and reported vocabularies ($^{\Delta}R^2 \geqslant 0{\cdot}18$, $p < 0{\cdot}05$; final equation $F[3, 16] \geqslant 6{\cdot}12$, $p < 0{\cdot}01$). For observed vocabularies, mothers' provision of follow behavioural directives, a measure of supportive directiveness contributed positively ($^{\Delta}R^2 = 0{\cdot}13$, $p < 0{\cdot}05$;) and their provision of lead attentional directives contributed negatively to the final equation ($^{\Delta}R^2 = 0{\cdot}09$, $p = 0{\cdot}07$; final equation $F[4, 15] = 10{\cdot}49$, $p < 0{\cdot}001$). Beta weights confirmed the positive contributions of children's prior vocabularies to all three final equations (final $\beta \geqslant 0{\cdot}39$, $p < 0{\cdot}05$) and of

TABLE 5. *Hierarchical regressions predicting children's lexicons at* 1;5 *from maternal responsiveness and directiveness measures at* 1;1

Predictors	Total lexicons at 1;5				Reported lexicons at 1;5				Observed lexicons at 1;5			
	F(equation)	*Adj.* R^2	ΔR^2	Final β	*F*(equation)	*Adj.* R^2	ΔR^2	Final β	*F*(equation)	*Adj.* R^2	ΔR^2	Final β
Maternal responsiveness at 1;1	24·34***	0·79			23·31***	0·78			16·12***	0·76		
Control factors:			0·39*				0·35*				0·51**	
Children's lexicons				−0·02				0·00				−0·40
Mothers' utterance frequencies				−0·05				−0·05				−0·01
Responsiveness measures in the equation:												
Verbal imitation			0·43***	0·93***			0·47***	0·91***			0·25***	1·15***
Follow descriptions											0·04[a]	0·30[a]
Maternal directiveness at 1;1	6·96**	0·48			6·12**	0·45			10·49***	0·67		
Control factors:			0·39*				0·35*				0·51**	
Children's lexicons				0·56**				0·55**				0·39*
Mothers' utterance frequencies				0·50*				0·52*				0·13
Directiveness measures in the equation:												
Lead attentional directives			0·18*	−0·48*			0·19*	−0·50*			0·09[a]	−0·45**
Follow behavioural directives											0·13*	0·55*
Maternal responsiveness and directiveness at 1;1	22·18***	0·82			20·41***	0·80			14·04***	0·77		
Control factors:			0·39*				0·35*				0·51**	
Children's lexicons				0·04				0·07				−0·27
Mothers' utterance frequencies				0·10				0·10				0·36[a]
Responsiveness predictor:			0·43***				0·47***				0·25***	
Verbal imitation				0·83***				0·81***				0·94**
Directiveness predictor(s):			0·04[a]				0·03[a]				0·07[a]	
Lead attentional directives				−0·23[a]				−0·22[a]				−0·32*
Follow behavioural directives												0·01

[a] $p \leqslant 0{\cdot}10$, * $p \leqslant 0{\cdot}05$, ** $p \leqslant 0{\cdot}01$, *** $p \leqslant 0{\cdot}001$.

mothers' earlier utterance frequencies to predictions for total and reported lexicons (final $\beta \geqslant 0{\cdot}50$, $p < 0{\cdot}05$). Mothers' production of lead attentional directives was a negative predictor in all three equations (final $\beta \leqslant -0{\cdot}45$, $p < 0{\cdot}05$), while their provision of follow behavioural directives was also an independent positive predictor of children's observed vocabularies (final $\beta = 0{\cdot}55$, $p < 0{\cdot}05$).

The final analyses for this interval tested whether the significant directiveness measures at 1;1 – lead attentional directives for total and reported lexicons and both lead attentional directives and follow behavioural directives for observed lexicons – made additional contributions to the predictions of children's lexicons at 1;5, beyond the control factors and the significant verbal responsiveness predictor, verbal imitation. After inclusion of the control and responsiveness measures, addition of mothers' lead attentional directives just missed statistical significance in contributing to predictions of children's total and reported lexicons ($^{\Delta}R^2 \geqslant 0{\cdot}03$, $p \leqslant 0{\cdot}10$). Addition of the two significant directiveness measures to the prediction of children's observed vocabularies also just missed significance ($^{\Delta}R^2 = 0{\cdot}07$, $p = 0{\cdot}09$), although lead attentional directives was a significant independent predictor in the final equation (final $\beta = -0{\cdot}32$, $p < 0{\cdot}05$).

Predictors of children's lexicons at 1;9. In the interval from 1;5 to 1;9, mothers' verbal and behavioural responsiveness and supportive behavioural directiveness positively predicted, while mothers' verbal intrusive directiveness negatively predicted, children's total, reported, and observed vocabularies (see Table 6).

In analyses of maternal responsiveness, inclusion of the control factors contributed significantly to predictions of all three lexicons ($^{\Delta}R^2 \geqslant 0{\cdot}57$, $p \leqslant 0{\cdot}001$). Mothers' rated behavioural responsiveness made an additional significant contribution to the predictions of children's total and reported lexicons ($^{\Delta}R^2 = 0{\cdot}16$, $p < 0{\cdot}01$, for each), and their provision of follow descriptions added significantly to predictions of all three measures of children's lexicons ($^{\Delta}R^2 \geqslant 0{\cdot}05$, $p \leqslant 0{\cdot}05$). Beta weights for the final equations showed that children's vocabularies at 1;5 and the significant maternal responsiveness measures were independent positive predictors of children's total, reported, and observed vocabularies at 1;9 (final $\beta \geqslant 0{\cdot}41$, $p < 0{\cdot}05$). With all variables in the equations, mothers' earlier utterance frequencies, despite non-significant positive zero-order correlations to the outcome measures, proved to be significantly negatively predictive of children's subsequent total and reported lexicons (final $\beta \leqslant -0{\cdot}53$, $p < 0{\cdot}05$), and the equation for observed lexicons showed a similar trend (final $\beta \leqslant -0{\cdot}53$, $p < 0{\cdot}08$), suggesting that mothers' provision of fewer utterances but a greater proportion of them follow descriptions was predictive of larger vocabularies. Together the control factors and responsiveness predictors accounted for 61% to 79% of the variance in the three measures of

TABLE 6. *Hierarchical regressions predicting children's lexicons at* 1;9 *from maternal responsiveness and directiveness measures at* 1;5

Predictors	Total lexicons at 1;9				Reported lexicons at 1;9				Observed lexicons at 1;9			
	F(equation)	*Adj.* R^2	$^{\Delta}R^2$	Final β	*F*(equation)	*Adj.* R^2	$^{\Delta}R^2$	Final β	*F*(equation)	*Adj.* R^2	$^{\Delta}R^2$	Final β
Maternal responsiveness at 1;5	18·91***	0·79			18·62***	0·79			10·72***	0·61		
Control factors:			0·62***				0·62***				0·57***	
Children's lexicons				0·67***				0·68***				0·65**
Mothers' utterance frequencies				−0·55*				−0·53*				−0·55[a]
Responsiveness measures in the equation:												
Responsiveness rating			0·16**	0·41**			0·16**	0·42**				
Follow descriptions			0·06*	0·51*			0·05*	0·48*			0·10*	0·66*
Maternal directiveness at 1;5	17·99***	0·78			16·98***	0·77			12·76***	0·71		
Control factors:			0·62***				0·62***				0·57***	
Children's lexicons				0·55**				0·59***				0·49*
Mothers' utterance frequencies				0·04				0·03				−0·05
Directiveness measures in the equation:												
Lead attentional directives			0·17**	−0·44**			0·15**	−0·40**			0·14*	−0·44*
Achievement orientation rating			0·04[a]	0·25[a]			0·05[a]	0·28[a]			0·07*	0·30*
Maternal responsiveness and directiveness at 1;5	23·36***	0·85			20·57***	0·84			9·71***	0·70		
Control factors:			0·62***				0·62***				0·57***	
Children's lexicons				0·46***				0·50***				0·51*
Mothers' utterance frequencies				−0·09				−0·11				−0·20
Responsiveness predictor(s):			0·22**				0·21**				0·10*	
Responsiveness rating				0·42**				0·43**				
Follow descriptions				0·02				0·03				0·16
Directiveness predictor(s):			0·06*				0·05*				0·11[a]	
Lead attentional directives				−0·42**				−0·38*				−0·37
Achievement orientation rating												0·29[a]

[a] $p \leqslant 0{\cdot}10$, * $p \leqslant 0{\cdot}05$, ** $p \leqslant 0{\cdot}01$, *** $p \leqslant 0{\cdot}001$.

children's vocabularies at 1;9 (final equation $F[4, 15] \geqslant 18{\cdot}62$, $p < 0{\cdot}0001$, for total and reported lexicons; final equation $F[3, 16] = 10{\cdot}72$, $p < 0{\cdot}001$, for observed lexicons).

Maternal behavioural and verbal directiveness also predicted children's vocabularies at 1;9 (final equation $F[4, 16] \geqslant 12{\cdot}76$, $p \leqslant 0{\cdot}0001$; adjusted $R^2 \geqslant 0{\cdot}71$). After the control factors had been taken into account, maternal production of verbally intrusive lead attentional directives was a significant negative predictor of all three measures of children's vocabularies ($^{\Delta}R^2 \geqslant 0{\cdot}14$, $p < 0{\cdot}02$; final $\beta \leqslant -0{\cdot}40$, $p < 0{\cdot}02$). In addition, mothers' achievement orientation ratings, an index of supportive directiveness, was a significant additional positive predictor of children's observed vocabulary ($^{\Delta}R^2 = 0{\cdot}07$, $p = 0{\cdot}05$; final $\beta = 0{\cdot}30$, $p = 0{\cdot}05$) and showed a trend in the equations for total and reported vocabularies ($^{\Delta}R^2 \geqslant 0{\cdot}04$, $p < 0{\cdot}08$; final $\beta \geqslant 0{\cdot}25$, $p < 0{\cdot}08$).

The final hierarchical regressions assessed whether the significant maternal directiveness predictors at 1;5 – lead attentional directives for all three lexicons and achievement orientation ratings for observed lexicons – added to predictions of children's vocabularies at 1;9, beyond the contributions of the control factors and the significant responsiveness measures, responsiveness ratings for total and reported vocabularies and follow descriptions for all three. Even after the control factors and responsiveness measures had been entered, mothers' production of lead attentional directives contributed significantly to the prediction equations for total and reported lexicons ($^{\Delta}R^2 \geqslant 0{\cdot}05$, $p < 0{\cdot}05$; final equation $F[5, 14] \geqslant 20{\cdot}57$, $p < 0{\cdot}0001$). Addition of mothers' lead attentional directives and achievement orientation showed a similar trend in contributing to the prediction of observed lexicons ($^{\Delta}R^2 = 0{\cdot}11$, $p = 0{\cdot}06$; final equation $F[5, 14] = 9{\cdot}71$, $p < 0{\cdot}001$). Together the control, responsiveness, and directiveness predictors accounted for from 70% to 85% of the variance in the three measures of lexical development at 1;9.

DISCUSSION

Maternal responsive behaviours and utterances have typically been regarded as facilitating (e.g. Carpenter *et al.*, 1998; Bornstein *et al.*, 1999; Tamis-LeMonda *et al.*, 2001) and maternal directive behaviours and utterances as hindering children's development, including language (e.g. Marfo, 1992; Mahoney & Neville-Smith, 1996; *cf.* review by Pine, 1992). Yet, evidence to support these assumptions has been frequently inconsistent or even contradictory, both for responsiveness (e.g. Akhtar *et al.*, 1991; Hoff & Naigles, 2002) and for directiveness (e.g. Barnes *et al.*, 1983; Tomasello & Todd, 1983). The present study, however, by systematically considering certain dimensions often not previously differentiated, has

uncovered a coherent pattern of significant predictive relations between measures of mothers' behavioural and verbal responsiveness and directiveness and their children's expressive vocabulary development. For the first time, a single study has examined multiple developmental periods, distinguished among types of predictor and outcome variables, and incorporated appropriate statistical controls.

The maternal characteristics associated with their children's lexical growth changed with development. During the period from 0;10 to 1;1, when children's first words are just emerging, behavioural, but not verbal, measures of mothers' responsiveness and supportive directiveness positively predicted their children's total and reported vocabularies, although children's observed production was too limited to yield significant findings. Moreover, the final hierarchical regression revealed that the directiveness measure made an independent contribution to the prediction of children's total vocabularies, beyond that of mothers' rated responsiveness. As a whole the control, responsiveness, and directiveness measures accounted for about three-quarters of the variance in children's lexical acquisition, a substantial proportion. It seems reasonable that the aspects of mothers' sensitive care captured by higher scores on the responsiveness and supportive achievement orientation ratings might foster such initial language regardless of the specifics of mothers' speech at that time.

The second time interval, from 1;1 to 1;5, encompassed a period when children often experience a vocabulary spurt. By 1;5, 8 of these children had accumulated reported vocabularies of 50 words or more, a milestone associated with rapid lexical acquisition and awareness that all objects are nameable (Nelson, 1973; Gopnik & Meltzoff, 1987). It was during this interval that features of maternal verbal interactions became predictive of children's lexical gains. Mothers' verbal imitation at 1;1, and their follow behavioural directives in the analysis of observed lexicons, were positively related to their children's subsequent lexicons, while their production of lead attentional directives was negatively related. These results are in accord with reports of a positive relation between maternal vocal imitation at 1;1 and children's rates of acquiring 50-word lexicons (Tamis-LeMonda *et al.*, 2001), a positive relation between mothers' provision of 'follow-prescriptives' at 1;1 and children's reported lexicons at 1;10 (Akhtar *et al.*, 1991; 44), and a negative relation between mothers' production of attention devices at 1;1 and children's reported vocabularies at 1;10 (Akhtar *et al.*, 1991), although those analyses did not adjust for one or both of the control factors included here. Mothers' production of the supportive behavioural directives which follow their children's attentional focus may foster comprehension of relevant objects and appropriate responses to requested actions (Akhtar *et al.*, 1991). Frequent provision of intrusive lead attentional directives, quite the opposite, may render children's mapping of words to

referents more difficult by requiring them to redeploy their attention and may frustrate children's communicative intentions by presenting labels for objects and actions at odds with their immediate interests (Tomasello & Todd, 1983; Bloom, 1993). Of these three measures, however, it was maternal verbal imitation that was by far the strongest predictor, as evidenced by the failure of the directiveness measure to contribute additionally to the predictions of children's total and reported lexicons. Mothers' matching of early words provides a response attuned to their children's semantic and attentional focus within the environment and may serve to highlight and reinforce their first attempts at verbal communication (Tamis-LeMonda *et al.*, 2001).

During the final developmental interval from 1;5 to 1;9, a period unaccountably omitted from previous investigations, the most lexically advanced children are likely to be acquiring more verbs and adjectives and developing rudimentary two-word utterances (Nelson, 1973; Bates *et al.*, 1988). In this interval, with maternal speech and child vocabulary controlled, measures of mothers' verbal and behavioural responsiveness and directiveness significantly predicted their children's lexicons. The responsiveness analyses revealed that mothers who provided more utterances describing aspects of the environment to which their children were currently attending had children who acquired larger total, reported, and observed vocabularies. Mothers' behavioural responsiveness also contributed to their children's development of greater reported and total vocabularies. Analyses of directiveness predictors found greater expansion in total, reported, and observed lexicons in children whose mothers produced fewer utterances redirecting their attentional focus. Increase in observed lexicons was also greater for children with mothers rated higher in supportive behavioural directiveness. The final analyses revealed that these directiveness measures contributed incrementally to the predictions even after control and responsiveness measures had been taken into account. In our view, the use of hierarchical regression techniques to assess the contribution of maternal directiveness, above and beyond control factors and responsiveness predictors, provides a methodological advance and yields a conceptual clarity sometimes not present in other investigations.

Although maternal behavioural responsiveness, supportive behavioural directiveness, and provision of lead attentional utterances had each proved predictive of one or more measures of children's lexical development during previous intervals, mothers' production of follow descriptions emerged clearly as a predictor only during the final interval. Like Akhtar *et al.* (1991) and Tamis-LeMonda *et al.* (2001), we did not find maternal follow descriptions at 1;1 associated with gains in children's reported vocabularies, although mothers' descriptions at 1;1 showed a trend in relation to children's observed production, a link not previously examined. It is possible that

mothers' production of utterances describing actions and events, even more so than those merely labelling objects, would be especially relevant to children whose language is accelerating during this final period. Thus, we believe that the semantic content of descriptions mothers provide during the first versus the second half of the second year to children developing language more or less rapidly deserves future study.

The distinctions guiding variable selection and definition in the present study also contributed to clarifying certain issues. In choosing verbal predictors, we incorporated both Pine's (1992) separation of attentional from behavioural directives and Akhtar *et al.*'s (1991) differentiation of utterances which follow a child's attentional focus from those which lead it. Our examination of follow behavioural directives and lead attentional directives allowed us to contrast highly supportive and highly intrusive verbal directiveness, a distinction we carried into the behavioural domain as well. With this distinction, meaningful predictive relations emerged. A measure of mothers' supportive directiveness was positively related to one or more measures of children's lexicons in every age period – achievement orientation from 0;10 to 1;1 and 1;5 to 1;9 and follow behavioural directives from 1;1 to 1;5. And mothers' intrusive verbal directiveness, as indexed by lead attentional directives, was negatively associated with children's subsequent total, reported, and observed vocabularies during all but the first interval. The simultaneous positive link of follow behavioural directives and negative link of lead attentional directives at 1;1 to children's observed lexicons at 1;5 might help explain why the study by Hoff & Naigles (2002) which combined behavioural and attentional directives did not find a predictive relation.

With respect to the outcome variable, however, the measures chosen produced similarity rather than contrast. Despite some continuing controversy in the literature over the use of maternal report rather than observational measures in assessing children's resultant vocabularies (Hoff & Naigles, 2002), the results for the two were remarkably consistent. Starting with the second time interval, most maternal measures significantly predicting one lexical measure significantly predicted the other as well. Among responsiveness scores, these included verbal imitation at 1;1 and follow descriptions at 1;5; among directiveness measures, lead attentional directives at 1;1 and at 1;5. In a further instance, achievement orientation at 1;5, the significant predictor of one vocabulary score showed a non-significant trend, just missing the 0·05 level of statistical significance, in predicting the other vocabulary score. In only two cases, follow behavioural directives at 1;1 and responsiveness ratings at 1;5, were significant predictors of one kind of lexicon completely unrelated to the other. The striking similarity in patterns of prediction to the two lexical measures further supports the validity of maternal report measures.

Finally, the rigorous requirement of instituting statistical controls for both children's initial vocabulary levels and mother's initial utterance frequencies affords us greater confidence in the robustness of these results. As expected, children's initial lexicons were virtually always positively predictive; but mothers' speech was, surprisingly, occasionally negatively predictive. It would be interesting to determine whether mothers' greater talkativeness, especially at 0;10 when the pattern held in all analyses, represented lengthy monologues not yet tailored to the communicate needs of their children. Yet, even while including appropriate statistical procedures, we recognize that because these analyses are correlational in nature our conclusions must remain tentative. We cannot know if there are other factors unaccounted for – some prior social or cognitive features of children which elicit or dampen mothers' responsive or directive dispositions. Perhaps the search for such possible characteristics should motivate the next step toward more interactive investigations of maternal responsiveness and directiveness.

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