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Sources of child vocabulary competence: a multivariate model*

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ABSTRACT

This study examines sources of individual variation in child vocabulary competence in the context of a multivariate developmental ecological model. Maternal sociodemographic characteristics, personological characteristics, and vocabulary, as well as child gender, social competence, and vocabulary competence were evaluated simultaneously in 126 children aged 1;8 and their mothers. Measures of child vocabulary competence included two measures each of spontaneous speech, experimenter assessments, and maternal reports. Maternal measures, from proximal to distal, included vocabulary, verbal intelligence, personality, attitudes toward parenting, knowledge of parenting, and SES. Structural equation modelling supported several direct unique predictive relations: child gender (girls higher) and social competence as well as maternal attitudes toward parenting predicted child vocabulary competence, and mothers' vocabulary predicted child vocabulary comprehension and two measures of mother-reported child vocabulary expression. In addition, children's vocabulary competence was influenced indirectly by mothers' vocabulary, social personality, and knowledge of child development. Maternal vocabulary itself was positively influenced by SES, maternal verbal intelligence, and mothers' knowledge about parenting. Individual variation in child vocabulary competence might best be understood as arising within a nexus of contextual factors both proximal and distal to the child.

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INTRODUCTION

Typically developing children exhibit generally similar patterns of language acquisition, yet rates of development are marked by striking individual variation. Notably, children of the same age vary dramatically among themselves on nearly every index of language competence. Understanding variation in any single domain of language acquisition is significant in its own right, and understanding sources of individual variation provides a way to identify influences that affect all language learners. Alongside the study of norms, therefore, individual differences as well as their sources of variation occupy a central position in the investigation of language development.

This study addresses the question of which specific characteristics of children and of mothers might influence the expression of individual variation in one specific aspect of children's early language ability, VOCABULARY COMPETENCE. We measured child vocabulary comprehension and expression in multiple ways, and we evaluated the contributions of a comprehensive set of factors in the child, in the mother, and in the context thought to predict variation in child vocabulary competence from a multivariate, ecological perspective. The literature concerning endogenous and exogenous sources of influence on the development of child language is rich. However, antecedents of child language competencies have typically been studied in isolation from one another, and few research efforts have incorporated multiple variables from diverse sources of influence simultaneously. Thus, the unique and combined contributions that each source may make to the development of a language ability in childhood are essentially unexplored. However, systems theorists have emphasized the growth in understanding to be gained from considering both the independence and interdependence of organismic and environmental determinants in predicting developmental outcomes (e.g. McCune, 1992; Bornstein, 1995).

A framework based on the ecological developmental perspective (see Bronfenbrenner & Crouter, 1983) was therefore developed for this study to identify important variables in the child, in the mother, and in the context of development underlying variation in children's vocabulary competence. We approached these analyses with a set of hypothesized relations that constituted an *a priori* model. This model allowed simultaneous testing of direct as well as indirect paths of influence of multiple variables on child vocabulary competence in an effort to define a single integrative view. The general model of theoretical relations that motivated our design and analyses is presented in Figure 1. Family sociodemographic characteristics, maternal personological characteristics, and maternal verbal behaviour are depicted in increasing proximity and increasing predictive relation to child vocabulary competence. SES and maternal personological characteristics were expected to exert

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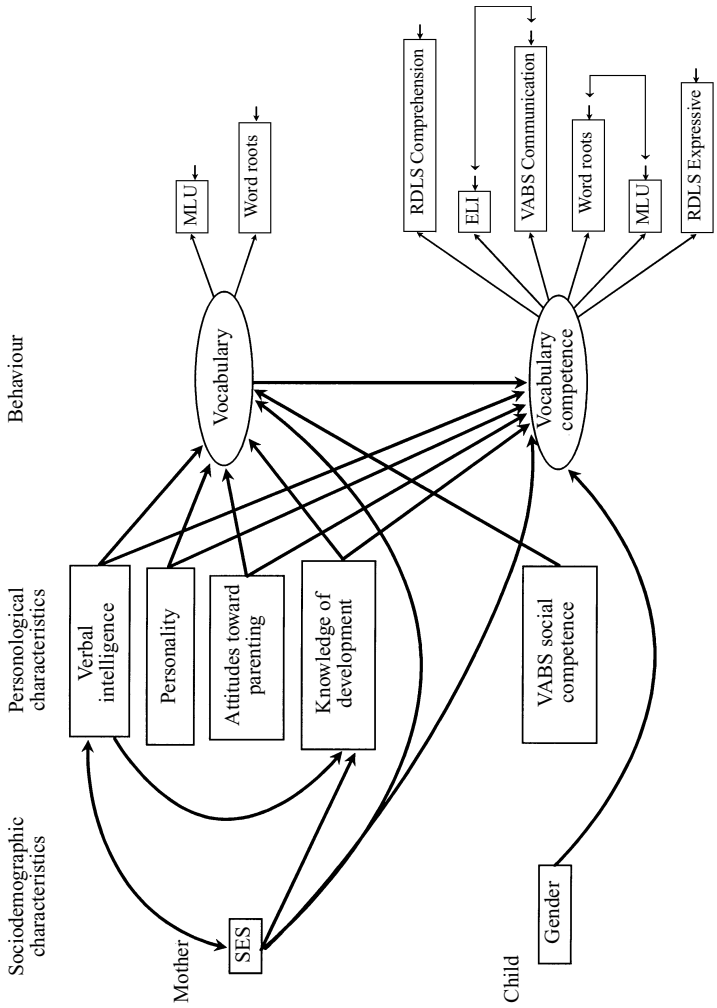


Fig. 1. Expected predictive relations between child and mother characteristics and child vocabulary competence.

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direct effects on child vocabulary competence as well as indirect effects mediated through maternal vocabulary. In addition, child gender was expected to predict child vocabulary competence directly, but child social competence was expected to affect child vocabulary competence only indirectly through its influence on maternal vocabulary. Peripheral hypotheses were that maternal verbal intelligence and SES influence mothers' knowledge of development and that verbal intelligence and SES covary. Structural equation modelling was used to test the fit of this complex model of hypothesized relations to the data and to evaluate the statistical significance of specific hypothesized and alternative paths within the model. In the discussion that follows, we elaborate first on the description of the dependent variable, child vocabulary competence, and then on rationales underlying the selection of proximal and distal factors in terms of their potential direct effects on child vocabulary competence.

Measures of child vocabulary competence

To evaluate vocabulary competence in children from a comprehensive perspective, we systematically examined relations among six measures of child vocabulary comprehension and expression derived from three sources, including observations of the children's speech with their mothers, experimenter assessments, and maternal reports. First, for this study we standardized a naturalistic situation under which we collected (and transcribed) child language samples: children were alert, under no stress, and engaged in normal play with mother using a standard toy set in the home. Second, we used an experimenter administered, age-normed assessment of language comprehension and expression in children, the *Reynell Developmental Language Scales – Second Revision* (RDLS; Reynell & Huntley, 1985). Third, for maternal reports we used the *Vineland Adaptive Behavior Scales* (VABS; Sparrow, Balla & Cicchetti, 1984) and the *Early Language Inventory* (ELI; Bates, Bretherton & Snyder, 1988).

Each of these orientations has a unique and valid perspective to contribute to the picture of a child's vocabulary competence, but each sighting also offers a potentially different perspective, with its particular implications of the representation of vocabulary competence. Different data sources also complement one another and converge to bring into focus a single coherent picture. No one source of developmental assessment is superior to all others under all situations; we therefore elected to investigate the contributions of different sources of information to the assessment of children's vocabulary competence.

Factors contributing to child vocabulary competence

To assess the relative contributions of diverse determinents to child vocabulary competence, we evaluated a model of hypothesized relations among

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a comprehensive set of factors from the context, the mother, and the child thought to play key roles in language development. Where the hypothesized model misspecified relations among the factors and their contributions to child vocabulary competence, the model was modified to achieve an integrated view of how, in the data, the various factors contributed directly and indirectly to child vocabulary competence.

First, certain characteristics of children doubtlessly contribute to variation in their vocabulary sophistication (see, e.g. Bornstein, 1985; McCune, 1992). For example, girls are reported to show somewhat advanced vocabulary and rates of language development relative to boys (Reynell & Huntley, 1985; Hyde & Linn, 1988; Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994). Huttenlocher, Haight, Bryk, Seltzer & Lyons (1991) found that early gender differences in the 'vocabulary spurt' obtained independent of vocabulary exposure. We expected child gender to relate to child vocabulary competence directly (Fig. 1).

Variation in child social competence could also relate to child vocabulary competence directly or influence a mother's use of vocabulary with her child (Smolak, 1987). For example, children aged 1;6 to 2;10 who score significantly lower in socialization skills as measured by the VABS are also reportedly slow in expressive vocabulary acquisition (Paul, Looney & Dahm, 1991), and mothers of withdrawn children engage in less contingent verbal interaction than do mothers of non-withdrawn children (LaFreniere & Dumas, 1992). We sought to capture children's social competence in their presentation of self to mother, and so we obtained information about mothers' perceptions of their children's social skills. We expected child social competence to exercise an indirect effect on child vocabulary competence through its effect on maternal vocabulary (Fig. 1).

A significant source of variation in children's vocabulary competence presumably lies in variation in their exposure to vocabulary: speech is a ubiquitous aspect of parenting. Children acquire vocabulary from speech they hear: they learn from and imitate vocabulary, and in conversation parents certainly elicit speech from their children (Hoff-Ginsberg, 1986). Vocabulary status in childhood is related to parental speech (e.g. Huttenlocher *et al.*, 1991; Bornstein & Tamis-LeMonda, 1995) and to adults' descriptions of the environment that occupy the child's attention (see Dunham & Dunham, 1992). Colorado Adoption Project investigators recorded rates of communicative development (vocabulary items from the *Bayley Scales*) in adopted one-year-olds (e.g. Hardy-Brown & Plomin, 1985): Development of children's communicative competence related to the verbal behaviour of their adoptive mothers, thereby revealing a direct association between caregiver verbal behaviour and child vocabulary independent of genetic influence. We expected mothers' vocabulary to exercise a direct influence over child vocabulary competence (Fig. 1).

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Maternal language *per se* is certainly not the sole parenting factor that predicts variation in child language, however. Diverse maternal personological characteristics exert direct effects on child language as well as indirect effects, through their influence on mothers' language: development in children as well as parenting practices are multiply determined (Bornstein, 1995). Characteristics that are antecedent to mothers' vocabulary use, and thus to child vocabulary competence, might include verbal intelligence, personality, attitudes toward parenting and interaction style, and knowledge of child development. Insofar as language use calls upon general cognitive competence, maternal verbal intelligence could directly (through genetic relations) or indirectly (through expressed language) account at least in part for individual variation in child vocabulary competence. Parental intelligence is associated with childhood vocabulary skills, even after controlling for verbal stimulation or other factors in the home environment (Bouchard, Lykken, McGue, Segal & Tellegen, 1990). In the Colorado Adoption Project, child communicative competence also related to the measured intelligence of the child's biological mother, pointing to genetic influences on individual differences in vocabulary competence independent of experience (Hardy-Brown & Plomin, 1985). By contrast, the common sense expectation that social and emotional aspects of maternal personality will influence child language development has not been as widely investigated: indeed, general studies of relations between parental personality and diverse factors in child development are few (Belsky, 1984). Exemplifying potential relations of maternal personality to child language, however, is the finding that mothers who are depressed speak less to their children than mothers who are not depressed (Breznitz & Sherman, 1987), and children of depressed mothers present with lower verbal IQ (Cohler, Gallant, Grunebaum, Weiss & Gamer, 1977).

Attitudes toward parenting and interaction style, and knowledge about child development, have been implicated in maternal childrearing activities as well as child development *per se* (e.g., Goodnow & Collins, 1990). The theoretical and empirical work of Bowlby and Ainsworth as well as their successors (e.g. van IJzendoorn, Dijkstra & Bus, 1995) suggests that a sensitive and responsive attitude toward parenting fosters child cognitive and verbal development. For example, Vibbert & Bornstein (1989) found that mothers' positive social interaction style, in combination with didactic stimulation, predicted their 13-month-olds' vocabulary sophistication. Mothers' knowledge of development helps to structure their interactions with their children and/or create a climate that nurtures development: as Ninio (1979) argued, believing that young children benefit from being talked to promotes mothers' engaging in verbal and other activities that, in turn, foster language development. Several studies have unearthed parallels between parents' estimates of developmental milestones and their intro-

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ducing new experiences, notably telling stories and reading to their children (e.g. Hess, Kashiwagi, Azuma, Price & Dickson, 1980). Thus, maternal personological characteristics pertinent to parenting – intelligence, personality, attitudes and style, and knowledge – were expected to exercise both direct and indirect effects on child vocabulary competence (Fig. 1).

Finally, socioeconomic status (SES) is believed to play a significant or even determinative role in the expression of diverse aspects of individual growth in childhood (see Hernandez, 1997; Hoff-Ginsberg & Tardif, 1995). In specific, SES relates to both child vocabulary and to maternal vocabulary (e.g. Capron & Duyme, 1989; Fenson *et al.*, 1994). Gottfried (1984) evaluated the results of seven separate longitudinal studies and found consistent positive associations between SES and child language; Reynell & Huntley (1985) reported a positive association between SES and child performance on the RDLS; and Hoff-Ginsberg (1995) found SES-associated differences in several measures of children's verbal development.

SES also affects maternal language, and thereby potentially child vocabulary competence. Ninio (1980) reported that upper-middle-class mothers talk, label, and ask 'what' questions more often than lower-class mothers do. Hoff-Ginsberg (1991) observed pervasive differences between high school-educated working-class and college-educated upper-middle-class mothers: middle-class mothers talked more in total, talked more per unit of time, and sustained longer bouts of verbal interaction. Middle-class mothers expose their children to a richer vocabulary, with longer sentences, and a greater number of word roots. Snow, De Blauw & Van Roosmalen (1979, p. 270) argued that the higher level of verbal activity which characterizes middle-class Western mothers may reflect beliefs and values that children are 'separate individuals with whom communication is possible and necessary', and that these mothers value having verbal, articulate children. Indeed, class differences in maternal verbal interactive style are frequently explained in terms of personological characteristics of mothers. SES was therefore expected to affect child vocabulary competence directly as well as indirectly through its influences on maternal language and on maternal characteristics that might vary with maternal education – namely, verbal intelligence and knowledge of child development (Fig. 1).

In overview, we assessed child vocabulary comprehension and expression using naturalistic records, performance on a standardized task, and via maternal reports, and in a multivariate, contextual framework using structural equation modelling we asked whether and how maternal vocabulary, personological, and sociodemographic characteristics, as well as child gender and social competence systematically predicted variation in child vocabulary competence.

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METHOD

Participants

Altogether 131 mothers and their firstborn children, 70 boys and 61 girls, were observed and completed all procedures. An additional six dyads participated but were excluded because of recording difficulties. Participants were recruited through mass mailings and newspaper advertisements. All participants were European American, native speakers of English, and all families were monolingual. All children were term at birth and had experienced no serious illnesses since birth; children had no known hearing or cognitive impairments. Children were 1;8·3 at the time of the observation, S.D. = 0;0·6. The development of vocabulary competence is one of the principal developmental tasks of the second year of life, and children this age are also sensitive and responsive to others, especially their mothers (e.g. Edwards, 1995). As a consequence, this period constituted a formative time to investigate variation in emerging child vocabulary competence and its sources.

Families were intact and of middle to upper-middle SES, $M = 54{\cdot}5$, S.D. = 10·5, range = 23–66, on the Hollingshead (1975) *Four Factor Index of Social Status*. Mothers averaged 32;7 years (S.D. = 4;1) and were typically college graduates ($M = 6{\cdot}0$ on Hollingshead education scale, S.D. = 1·0). At the time of the observation, 63 % of the mothers were employed, and of those who were ($n = 83$) about one-half worked part-time, $M = 32{\cdot}3$ hours/week (S.D. = 12·7); once outliers were removed (as described below), hours mothers worked per week did not covary with any measure of their own or their children's language.

Overall design

Mothers and children were observed in the home during a two-hour visit by one female experimenter. Mothers had been instructed that the experimenter was interested in children's cognitive and social skills development. In the week before a home visit, mothers received in the mail and completed a questionnaire evaluating child expressive vocabulary. During the visit, the following data were gathered: experimenter assessments of the child's vocabulary competence, measures of mother and child language during a free-play interaction together, a measure of maternal verbal intelligence, and sociodemographic information about the family. At the end of the visit, the experimenter left a set of questionnaires with the mother with instructions to complete and return by mail. The following maternal characteristics were assessed in these questionnaires: personality, attitudes about parenting, interaction style, and knowledge of child development, as well as mothers' tendency to answer in a socially desirable fashion. In a follow-up telephone

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interview ($M = 19{\cdot}8$ days later), mothers provided a report of their child's receptive and expressive vocabulary, and a measure of their child's social competence.

Child vocabulary competence

Six measures of child vocabulary were obtained from three sources: transcripts of children's speech with mother, experimenter assessments, and maternal reports.

Child speech. Data on children's language performance derived from transcripts of spontaneous speech in interaction with mother videotaped during 10 min of free play in the home. To reduce variability in the language sample that could be a function of extraneous differences in naturalistic settings, a standard set of toys was used in the free play. To assure that the language sample had been collected under optimal conditions, following the taping mothers and the experimenter evaluated the comfort and readiness of the child to participate. On 8-point scales (0–7), mothers rated children as in good health ($M = 5{\cdot}8$, S.D. $= 1{\cdot}5$) and as having engaged in typical play ($M = 5{\cdot}4$, S.D. $= 1{\cdot}3$), and experimenters rated children as alert ($M = 6{\cdot}1$, S.D. $= 0{\cdot}9$) and calm ($M = 5{\cdot}3$, S.D. $= 1{\cdot}6$).

The first 600 sec available from videotapes after the start of free play were transcribed verbatim by professional transcribers naive to all factors in the study. Each transcript was then checked against the videotape for accuracy by researchers other than the original transcriber. Utterances that were unintelligible to transcribers or whose content transcribers could not agree upon were marked as unintelligible. Transcripts were then coded following the conventions of the *Systematic Analysis of Language Transcripts* (SALT; Miller & Chapman, 1993). Free and bound morphemes were parsed to allow calculation of mean length utterance (MLU) in morphemes. Following SALT rules, an utterance was defined as a unit of speech representing a complete thought as indicated by intonation and/or pauses. Multiple utterances per turn are possible in a conversation. Two measures of each child's language were calculated: (1) The total number of different intelligible word roots a child produced in all utterances, that is a count of the number of different lexical items (ignoring inflections) and (2) the mean length of utterance in child speech based on a count of morphemes in complete and intelligible utterances. The mean number of morphemes in children's utterances has proven to be a reliable index of young children's grasp of vocabulary, and MLU is a reliable indicator of verbal as well as grammatical development in both child and adult speech (e.g. Rollins, Snow & Willett, 1996). Blake, Quartaro & Onorati (1993) reported child MLU highly reliable, $0{\cdot}69 \leqslant rs \leqslant 0{\cdot}82$.

Forty-three transcripts, randomly selected, were coded separately by two researchers, and agreement (intraclass correlation: ICC) between coders was

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calculated for each language measure: for word roots, ICC = 0·99, and for MLU, ICC = 0·96. Transcripts of 8 play sessions (6·1 %) were based on less than 600 sec of audible videotapes, M = 555 sec, range = 524–588 sec. For these transcripts, the measure of word roots was prorated to 600 sec.

Experimenter assessment. The experimenter administered the Verbal Comprehension Scale 'A' and the Expressive Language Scale of the *Reynell Developmental Language Scales – Second Revision* (RDLS; Reynell & Huntley, 1985). The RDLS is a standardized instrument for assessing verbal comprehension and expression among children aged 1–6 years. In the Verbal Comprehension Scale, the child is asked to demonstrate understanding of increasingly difficult expressions from labelled familiar objects through to assimilating higher-order verbal concepts. The Expressive Language Scale (appropriate to this age level) uses two subscales: structure and vocabulary. From the child's spontaneous expressions heard throughout the interview, the child's language 'structure' is assessed on a scale which ranges from 'vocalizations other than crying' to the 'use of complex sentences.' In the 'vocabulary' subscale, the child is asked to name familiar objects as well as objects and actions from pictures. Both scales are sensitive to individual variation and are reliable (see Reynell & Huntley, 1985): norms for the revised edition of the RDLS are based on a sample of 1318 children, and split-half reliability coefficients for the Verbal Comprehension 'A' and Expressive Language Scales are 0·82 and 0·93, respectively, for children of 1;6. Individual differences in RDLS performance also predict linguistic abilities such as syntactic complexity of speech, reading comprehension, and verbal intelligence (see Reynell & Huntley, 1985). In this study, two experimenter assessments of child vocabulary competence were used: the normed score of vocabulary comprehension and the normed score of vocabulary expression. Reliability (ICC) of administration of the RDLS was 0·95.

Maternal report. One week prior to the home visit, mothers received the *Early Language Inventory* (ELI; Bates *et al*., 1988) by mail and were asked to complete it on the basis of their general knowledge of the child. This inventory provides a measure of children's expressive vocabulary: mothers indicate which words in a 643-item checklist (including nouns, action verbs, and adjectives that are commonly used by children of this age) they had heard their own child spontaneously produce. The ELI is a checklist that was normed by the authors of the MacArthur CDI (Fenson, Thal & Bates, 1990) and used in the development of the CDI (Fenson *et al*., 1994). The six-week test–retest stability for a later adaptation of the ELI, Vocabulary Production (Toddler Form) of the MacArthur CDI (81 % of the words in either word list are in the ELI) exceeds 0·90 (Fenson *et al*., 1994). The total number of words that mothers reported their children produced on the ELI was calculated for each child.

The *Vineland Adaptive Behavior Scales – Interview Edition, Survey Form*

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(VABS; Sparrow *et al*., 1984) were used to assess mothers' estimates of their children's receptive and expressive communication skills. This semi-structured interview with mother, lasting approximately 45 min, was carried out by telephone by an independent trained staff member. The Receptive Subdomain of the VABS Communication Domain is based on responses to up to 13 items designed to assess children's abilities to attend to, listen, and understand communications and to follow instructions. The Expressive Subdomain is based on responses to up to 31 items designed to assess children's preverbal and early speech activity and use of speech in interaction and in expressing abstract and complex concepts. In a standardization sample of 200 children in their second year, split-half reliability coefficients for the subdomains were 0·75 and 0·92 for Receptive and Expressive communication, respectively. Test–retest reliability of the overall Communication Domain was 0·92 for 70 children between 0;6 and 2;11. The normed score of the Communication Domain was used.

Predictors of child vocabulary competence

Two child predictors of child vocabulary competence were included: gender and social competence.

Child social competence. The VABS were also used to gather reports from mothers about their children's social competence. The standard score of the scale for the Socialization Domain was used; it includes up to 40 items applicable to young children and consists of three subdomains: interpersonal relationships (e.g. shows desire to please, imitates adult tasks or phrases, and has friends), play skills (e.g. plays games with others, engages in make believe, shares toys), and coping skills (e.g. has good manners and follows rules).

In addition to SES, five maternal and contextual predictors of child vocabulary competence were included.

Maternal vocabulary. Two measures of each mother's language to her child were computed based on the transcripts described above: (1) word roots – total number of different word roots a mother produced in her complete and intelligible utterances, and (2) MLU – the complexity of a mother's speech based on a count of morphemes in her complete and intelligible utterances. These measures of maternal language have been widely adopted (e.g. Stevenson, Leavitt, Roach, Chapman & Miller, 1986). As described above, 43 transcripts were coded separately by two researchers, and agreement was calculated for each language measure: for word roots, ICC = 0·997, and for MLU, ICC = 0·998. The same procedure for prorating word roots was used for mothers as described above for children. Mothers rated themselves on a seven-point scale as comfortable (M = 5·3, S.D. = 1·5) and engaged in typical behaviour with their children (M = 5·6, S.D. = 1·4) during the recording session.

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Maternal verbal intelligence. The *Peabody Picture Vocabulary Test – Revised* (PPVT-R Form L; Dunn & Dunn, 1981) was administered to the mother at the end of the home visit. This instrument provides a reliable and valid standard score for maternal verbal-perceptual vocabulary intelligence.

Maternal personality. Eleven of the 16 subscales of the *Jackson Personality Inventory* (JPI; Jackson, 1976) were self-administered. The JPI is designed to assess a variety of personality traits in adults. Following the factor structure reported for a sample of 215 college students, the principal component (anxious sociability) of three subscale scores, mothers' interpersonal affect, social participation, and higher anxiety (range of loadings = 0·69 to 0·82), accounting for 54% of their total variance, was used as the single measure of personality in mothers.

Maternal attitudes toward parenting. Five self-report measures were collected with the expectation that their shared variance would be used as a single estimate of mothers' attitude toward their own parenting. Three were measures of parental competence, satisfaction, and role balance, and they were assessed using the *Self-Perceptions of the Parental Role* (SPPR; MacPhee, Benson & Bullock, 1986), a 22-item inventory. Two were measures of parental social and didactic style, and they were assessed with the *Parental Style Questionnaire* (PSQ; Bornstein, Tamis-LeMonda, Pascual, Haynes, Painter, Galperín & Pêcheux, 1996), a 16-item inventory that evaluates social interaction (mothers' self-reported sensitivity, expressions of affection, and positive responsiveness to the child) and didactic/material caregiving (mothers' self-reported activity in providing didactic and material stimulation and in organizing an environment conducive to exploration). It was expected that mothers who felt positive about their parenting would evaluate themselves as competent and satisfied in their parenting, as having achieved a balance in their maternal and other roles, and as being socially sensitive and affectionate and didactically stimulating with their children. In the current sample, the five measures loaded (range = 0·48 to 0·75) on a single principal component, accounting for 42% of the total variance, which was used as a single measure of positive attitude toward parenting.

Maternal knowledge of child development. The *Knowledge of Infant Development Inventory* (KIDI; MacPhee, 1981) comprises 75 items covering four general areas: norms and milestones, principles (developmental processes), parenting (strategies), and health and safety (guidelines). It was used to assess mothers' knowledge of parental practices, developmental processes, and norms which form a knowledge base that may influence and regulate parental behaviour *vis-à-vis* a child. The measure used was the proportion of the total scores that were correct.

Social desirability. The *Social Desirability Scale* (SDS; Crowne & Marlowe, 1960) uses 33 items to assess adults' tendency to respond to questions in a socially desirable fashion. This scale was used to estimate the

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degree to which maternal reports may be contaminated in the VABS, JPI, SPPR, and PSQ.

RESULTS

The findings are presented in two main parts. First, we provide descriptive data on child language measures and child and maternal predictors of child vocabulary competence. Second, we evaluate a model of relations among predictors that was hypothesized to account for variation in child vocabulary competence (Fig. 1) and then present a model modified, within the limits of theoretical plausibility and parsimony, to fit the data. Prior to any analyses, univariate distributions of all variables were checked for normalcy and outliers, residuals examined for influential points in preliminary regressions, and the distance of each case to the centroid was evaluated to screen for multivariate outliers. As additional checks against unduly influential cases, Mardia's coefficient of multivariate kurtosis, the cases that contributed most to that estimate, and the cases that contributed disproportionately to parameter variances, were evaluated in each model, and the stability of parameter estimates were monitored across models. At the univariate level, child MLU was re-expressed using a log base 10 transformation to approximate normality and reduce the number and influence of outliers. Four cases were identified as multivariate outliers and were eliminated from all analyses. In preliminary models, one case was identified as contributing disproportionately to the parameter variances and was eliminated from all analyses, resulting in a final sample size of 126 cases, 68 boys and 58 girls.

Descriptive statistics

Child language. Table 1 shows the means and standard deviations for six child language measures (for the total sample and for girls and boys separately). Children's mean MLU was within 1 S.D. of means previously reported in studies of other children aged 1;7 to 1;9 (e.g. Weismer, Murray-Branch & Miller, 1994). Children's mean Reynell Comprehension score was less than 1 S.D. above the normed average, and their mean Reynell Expressive score was average. The number of words that mothers reported their children used, prorated for the number of items shared by the ELI and the CDI, was well within the range for children 1;8 on the ELI (Fenson *et al.*, 1990) and on the CDI (Fenson *et al.*, 1994). The children's Communicative Domain of the VABS was at the 1;8 norm (Sparrow *et al.*, 1984). Girls scored higher than boys in the vocabulary measures considered jointly, $F(6, 119) = 2{\cdot}87$, $p < 0{\cdot}05$, and in five of the six measures at the univariate level (see Table 1). However, the variance–covariance matrices were not different for girls and boys.

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TABLE 1. *Child language : descriptive statistics*

Child Language	Overall Mean	Overall S.D.	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Univariate $F(1, 124)$
Word roots	23·60	14·28	20·27	13·26	27·50	14·55	8·52**
Mean length utterance	1·38	0·31	1·34	0·32	1·42	0·28	2·21
RDLS Comprehension[a]	0·83	1·13	0·57	1·11	1·14	1·08	8·57**
RDLS Expressive[a]	0·21	1·02	−0·09	1·04	0·56	0·88	14·03***
ELI vocabulary	131·03	107·83	106·29	100·09	160·04	110·16	8·22**
VABS Communication[a]	104·80	11·83	102·34	11·93	107·69	11·12	6·70*

[a] Standard score.
* $p \leqslant 0{\cdot}05$; ** $p \leqslant 0{\cdot}01$; *** $p \leqslant 0{\cdot}001$.

TABLE 2. *Predictors of child vocabulary competence : descriptive statistics*

	Mean	S.D.
Child		
Gender	—	—
VABS Social Competence[a]	105·02	8·18
Mother		
Language		
Word roots	152·07	32·55
Mean length utterance	4·03	0·63
Verbal intelligence[a]	110·56	12·66
Personality		
Interpersonal affect	48·79	8·16
Social participation	47·12	9·09
Anxiety	47·27	10·19
Attitudes toward parenting		
Competence	4·15	0·56
Satisfaction	4·78	0·29
Role balance	3·79	0·67
Social interaction style	4·47	0·35
Didactic style	3·85	0·35
Knowledge of child development	0·82	0·05
SES (Hollingshead Index)	54·52	10·25

[a] Standard score.

Predictor variables. The means and standard deviations of potential predictors of child vocabulary competence are presented in Table 2. Children's social competence was reported by mothers to be only slightly higher than the age-based norm (Sparrow *et al*., 1984). Mother's word roots

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and MLU were within 1 S.D. of those reported for 33 upper-middle class mothers in a play situation with their children aged 1;9 (Hoff-Ginsberg, 1991). Mothers' verbal intelligence was within 1 S.D. of the adult norm (Dunn & Dunn, 1981). Mothers' standard scores on the JPI scales were all close to the norm for adult females (Jackson, 1976). Mothers' reports of their competence, satisfaction, and role balance in parenting were comparable to those previously reported by MacPhee *et al.* (1986) for mothers of one- to four-year-olds; and mothers tended to see themselves as sensitive, affectionate, and responsive when interacting with their children and as providing didactic and material stimulation, as much as mothers in three cultures who served as a reference group (Bornstein *et al.*, 1996). Mothers' knowledge of child development was higher than that for a reference group of mothers and only somewhat lower than that for groups of developmental psychologists and pediatricians (MacPhee, 1981).

The tendency of mothers to answer in a socially desirable fashion ($M = 16{\cdot}9$, S.D. $= 4{\cdot}4$) was only slightly greater than that generally reported for adult females by other researchers (O'Grady, 1988). Correlations between social desirability and mothers' reports of children's social competence and the principal components representing mothers' personality and attitudes toward parenting ranged (in expected directions) from $-0{\cdot}27$ to $0{\cdot}27$. To adjust for differences in socially desirable responsiveness, residuals of the social competence measure, and of the principal components of personality and parenting attitudes, controlling for socially desirable responsiveness, were computed and used as predictors of child vocabulary competence.

An expected moderate correlation was observed between mothers' age and their SES, $r = 0{\cdot}37$, $p < 0{\cdot}001$. To adjust for the effects of mothers' age in relations of SES with child vocabulary competence and other predictors of child vocabulary competence, the residual of SES controlling for mothers' age was used as a predictor.

Prediction of child vocabulary competence

Zero-order relations. Table 3 presents zero-order correlations among child measures and between child and maternal measures (predicted relations were evaluated at 1-tail significance; others at 2-tail). Child language measures covaried without exception. Child gender and social competence covaried with all language measures, except for MLU. Child social competence and gender did not covary. Maternal word roots and MLU related to children's verbal comprehension (RDLS), but only maternal word roots related to maternal report of child ELI. Among personological and sociodemographic variables, maternal personality related to child ELI, maternal parenting attitudes related to all measures of child language except MLU, maternal knowledge of child development related to child comprehension (RDLS) and the two maternal reported expressive measures (ELI and VABS), and

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TABLE 3. *Zero-order correlations among child variables and between child and mother variables*

	Child							
	MLU	Word roots	RDLS Comprehension	RDLS Expressive	ELI vocabulary	VABS Communication	Gender	Social Competence
Child								
Word roots	0·39***	—	—	—	—	—	—	—
RDLS Comprehension	0·16*	0·20*	—	—	—	—	—	—
RDLS Expressive	0·36***	0·70***	0·41***	—	—	—	—	—
ELI vocabulary	0·27***	0·64***	0·42***	0·78***	—	—	—	—
VABS Communication	0·22**	0·54***	0·30***	0·65***	0·73***	—	—	—
Gender (Boy = 0, Girl = 1)	0·13	0·25**	0·25**	0·32***	0·25**	0·23**	—	—
Social Competence[a]	0·14	0·28***	0·35***	0·35***	0·49***	0·56***	0·06	—
Mother								
Word roots	−0·05	0·14	0·22**	0·06	0·17*	0·10	−0·10	0·17*
MLU	0·08	−0·18†	0·18*	−0·07	0·09	0·10	−0·10	0·21*
Verbal intelligence	−0·01	−0·07	0·11	−0·06	0·10	0·07	−0·12	0·17
Personality[a]	−0·04	0·08	0·04	0·14	0·19*	0·03	0·09	0·18†
Attitudes toward parenting[a]	0·06	0·23**	0·19*	0·16*	0·24**	0·27***	0·01	0·24††
Knowledge	0·07	0·10	0·19*	0·14	0·26**	0·19*	0·04	0·19†
SES[b]	0·10	0·04	0·22**	0·12	0·18*	0·13	0·11	0·21†

[a] Residual controlling for social desirability.
[b] Residual controlling for mother's age.
*$p \leqslant 0{\cdot}05$; **$p \leqslant 0{\cdot}01$; ***$p \leqslant 0{\cdot}001$ (1-tailed).
†$p \leqslant 0{\cdot}05$; ††$p \leqslant 0{\cdot}01$ (2-tailed).

SES related to comprehension (RDLS) and the ELI. All maternal predictors, except verbal intelligence, related to child social competence.

Table 4 presents zero-order correlations among maternal measures. Mothers' MLU covaried with their word roots. Notably, three maternal predictor variables covaried with mothers' word roots and MLU: maternal verbal intelligence, maternal knowledge of child development, and SES. Maternal intelligence, maternal knowledge of child development, and SES, all covaried.

Data analytic strategy. Structural equation models were tested for their fit to the data using a maximum likelihood (ML) function, following the mathematical model of Bentler & Weeks as implemented in EQS (Bentler, 1995). The normalized estimate of Mardia's coefficient indicated that the data in all models were approximately multivariate normal. As a precaution, however, all χ^2 tests were corrected using the Satorra–Bentler scaling factor (S–B χ^2) which performs well under conditions of non-normalcy (Hu & Bentler, 1995). Because theoretically based models rarely fit the data well, modification of the *a priori* model was anticipated: single paths were added sequentially to a model that contained only those paths in the *a priori* model that had achieved statistical significance. At each step, the standardized residual covariance matrix was studied, potential paths were evaluated for their theoretical plausibility and empirical probability as suggested by the LaGrange Multiplier Test, and existing paths were re-evaluated for their continued probability with the Wald test. Fit was assessed using multiple, convergent indices especially the robust comparative fit index (RCFI) and the root mean square error of approximation (RMSEA). The significance of individual paths was assessed by nested, single degree-of-freedom χ^2-tests and z-tests of the ratio of parameter coefficients to their robust standard error estimates.

The fits of the *a priori* and modified models predicting child vocabulary competence are reported in Table 5. Models that are constructed by sequentially testing the addition and removal of paths, even when selection of paths is guided by theoretical relevance and plausibility, tend to exploit ungeneralizable relations in the data. For this reason, the final model is treated as having tentative explanatory value, suggesting relations for testing in future research.

Predicting child vocabulary competence. An initial measurement model was fitted for the latent variable for child vocabulary competence with six reflective indicators: word roots and MLU observed, verbal comprehension and expression assessed by the experimenter (RDLS), expression assessed by mother (ELI), and maternal report of child communication competence (VABS). Error terms between the two indicators of observed speech (word roots and MLU) and between the two maternal report indicators (ELI and VABS) were allowed to covary. Fit indices for the model (Model 1) in Table

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TABLE 4. *Zero-order correlations among mother variables*

	Word Roots	MLU	Verbal intelligence	Personality[a]	Attitudes toward parenting[a]	Knowledge
MLU	0·53***	—	—	—	—	—
Verbal intelligence	0·24**	0·39***	—	—	—	—
Personality[a]	−0·03	−0·09	−0·18†	—	—	—
Attitudes toward parenting[a]	0·14	0·05	0·09	−0·11	—	—
Knowledge	0·27***	0·31***	0·24**	0·02	0·06	—
SES[b]	0·25**	0·35***	0·31***	−0·04	0·10	0·22**

[a] Residual controlling for social desirability. [b] Residual controlling for mother's age.
** $p \leqslant 0{\cdot}01$; *** $p \leqslant 0{\cdot}001$ (1-tailed). † $p \leqslant 0{\cdot}05$ (2-tailed).

TABLE 5. *Goodness-of-fit indices for structural equation models*

Model	S–B χ^2	d.f.	p	RCFI	RMSEA	90% CI
Model 1. Measurement model for child vocabulary competence latent variable	10·25	7	0·18	0·99	0·054	0·000, 0·129
Model 2. *A priori* model (Figure 1)	179·61	79	0·001	0·82	0·097	0·076, 0·116
Model 3. Final model (Figure 2)	102·67	80	0·05	0·96	0·045	0·000, 0·070
Model 4. Model 3 freeing two sets of covarying errors between mother and child vocabulary competence	77·45	78	0·50	1·00	0·000	0·000, 0·047
Model 5. Model 3 less paths from mother vocabulary to child language indicators	125·69	83	0·002	0·92	0·062	0·036, 0·083
Model 6. Model 5 plus path from mother vocabulary to child vocabulary competence	126·46	82	0·003	0·92	0·063	0·038, 0·085
Model 7. Model 3 plus path from maternal verbal intelligence to child vocabulary competence	101·78	79	0·05	0·96	0·045	0·000, 0·070
Model 8. Model 3 plus path from maternal anxious sociability to child vocabulary competence	102·38	79	0·04	0·96	0·046	0·000, 0·071
Model 9. Model 3 plus path from maternal knowledge of child development to child vocabulary competence	102·16	79	0·05	0·96	0·045	0·000, 0·070

5 indicate the measurement model fitted the data adequately (the measurement model is available from the authors). Standardized coefficients for the paths between the latent variable and its indicators were moderate-to-large in magnitude (range = 0·37 to 0·93) and significant at the 0·001 level or better, suggesting that the latent variable for child vocabulary competence was reliably estimated and interpretable.

An *a priori* structural equation model predicting child vocabulary competence that represented hypothesized relations (Fig. 1) was fitted with child vocabulary competence as the dependent latent variable and a latent predictor variable for maternal vocabulary using word roots and MLU as indicators. All other predictors in the model were treated as measured variables. SES and maternal verbal intelligence were allowed to covary. As the indices in Table 5 (Model 2) show, however, the *a priori* model did not fit the data. Of the 16 hypothesized paths in the structural model, parameter estimates were statistically significant for eight: child gender to child vocabulary competence, maternal attitudes and child vocabulary competence, maternal knowledge of development to both maternal vocabulary and child vocabulary competence, SES to maternal vocabulary, maternal verbal intelligence to both maternal vocabulary and maternal knowledge of development, and the covariance of SES and maternal intelligence.

Figure 2 presents the standardized solution, and Table 5 (Model 3) presents the fitted indices, for a final model that was modified from the *a priori* model following the strategy described earlier. A major difference of substantive interest between the final and *a priori* models was the replacement of a path from mother vocabulary to child vocabulary competence with paths from mother vocabulary to three indicators of child vocabulary competence. Table 5 presents the fitted indices for a model without any paths from the latent variable for mother vocabulary to the latent variable for child vocabulary competence or its indicators (Model 5) and for a comparison model with a path from the latent variable for mother vocabulary to the latent variable for child vocabulary competence (Model 6): the standardized coefficient for the path between the two latent variables was 0·03, and a single degree-of-freedom χ^2 test of the improvement in the model was not significant, S–B χ^2 (1, $N = 126$) = 0·06, $p \leqslant 0{\cdot}82$. A second substantive difference between the final and *a priori* models was the reconceptualization of relations among child social competence, mother vocabulary, and child vocabulary competence: in the *a priori* model, mother vocabulary mediates the effects of child social competence on child vocabulary competence; in the final model, child social competence mediates the effects of mother vocabulary on child vocabulary competence. This reconceptualization was occasioned by the small standardized coefficient (0·11, $z = 1{\cdot}23$, $p \leqslant 0{\cdot}22$) for the path in the *a priori* model from child social competence to mother vocabulary and by recognition that the largest standardized residuals (range

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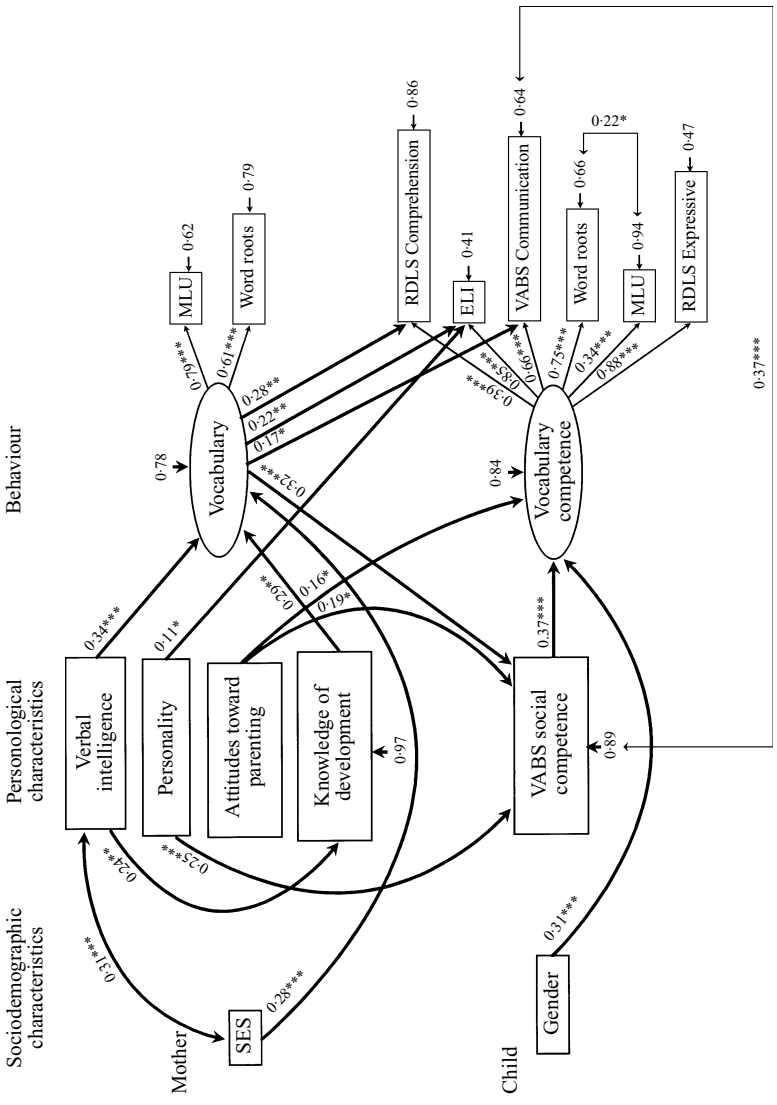


Fig. 2. Final model of predictive relations between child and mother characteristics and child vocabulary competence. Numbers associated with paths between variables are standardized path coefficients. (Numbers associated with dependent variables are error and disturbance values, which, when squared, represent the amount of variance not accounted for by predictor variables.) ELI = *Early Language Inventory*; VABS = *Vineland Adaptive Behavior Scales*; and RDLS = *Reynell Developmental Language Scales*. All parameters significant at $\alpha = 005$ or better.

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= 0·28 to 0·56; compare the correlations in Table 3) in the model were from child social competence to five indicators of child vocabulary competence. Other important differences between the final and *a priori* models were the exclusion of paths from maternal verbal intelligence, anxious sociability, and knowledge of development to child vocabulary competence. Table 5 presents fit indices for models with (Models 7, 8 and 9) and without (Model 3) those paths; in none of these model comparisons did the addition of a path significantly improve the fit, S–B χ^2 (1, $N = 126$) = 0·89, 0·29 and 0·51, respectively, *ps ns*. The fit of the final model could have been improved by freeing correlated error terms between two sets of indicator variables derived from identical measurement procedures: MLU in mother and child and word roots in mother and child (see Table 5, Model 4). It was decided not to represent this shared method variance in the final model because the fit of the final model was adequate and the relation of mother vocabulary to child vocabulary competence was of primary theoretical interest.

All parameters estimated in the final model were significant at $p \leqslant 0{\cdot}05$ or lower. Of primary interest are the direct paths to the latent variable of child vocabulary competence and its effect indicators. Looking at relations in the child first, 29·4% of the variance in the latent variable for child vocabulary competence was accounted for by all direct and indirect paths to it – primarily by child gender, child social competence, and positive attitudes toward parenting: girls manifested more developed vocabulary than boys, and greater mother-reported child social competence and more positive parenting attitudes predicted greater child language competence. In addition, maternal vocabulary accounted for variance in child comprehension and in the two maternal reported child language measures that was unrelated to their latent variable: maternal vocabulary predicted increased child RDLS verbal comprehension, the ELI, and VABS communication, but not the variance shared by the six language measures.

Indirect paths to the latent variable of child vocabulary competence and relations among predictor variables accounted for all other significant paths in the model. Mothers' vocabulary and anxious social personality predicted greater child social competence; in turn, mothers' vocabulary and personality influenced child vocabulary competence by way of child social competence (standardized indirect effects = 0·12 and 0·09, respectively, ps $\leqslant 0{\cdot}01$). Mothers' knowledge of child development predicted mothers' vocabulary and influenced child vocabulary competence by way of mothers' vocabulary and child social competence (standardized indirect effect = 0·03, $p \leqslant 0{\cdot}04$; note that the significant direct effect of knowledge of development on child vocabulary competence that was represented in the *a priori* model attenuated to non-significance when the relation of child social competence with mother vocabulary was reconceptualized). Mothers' vocabulary was predicted by their SES, verbal intelligence, and knowledge of child development. SES,

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verbal intelligence, and knowledge of child development indirectly influenced three of the six child vocabulary competence indicator variables through mothers' vocabulary (standardized indirect effects ranging from 0·03 to 0·14, ps $< 0{\cdot}05$), but were unrelated to the child vocabulary competence latent variable. Finally, mothers' verbal intelligence predicted their greater knowledge of child development.

DISCUSSION

This research was designed to examine multiple factors that may contribute to individual variation in young children's vocabulary competence. Developmental research is increasingly focused on addressing multivariate questions that look at specific variables in relation to specific outcomes (e.g. Bornstein, 1989). The approach of this study was to take a broad range of theoretically relevant determinants in an ecological framework into account in a relatively sizeable sample and to employ structural equation modelling to help to examine both the expression of individual variation in a multivariate examination of language comprehension and expression in very young children and to decompose these multiple sources of variation in terms of their potential direct and indirect effects. Our findings indicate that specific aspects of child and of mother account for variation in child vocabulary knowledge and use. We hypothesized that distal sociodemographic factors affect vocabulary competence in children directly and that they are also mediated by parent belief systems and by parent–child interactions. The literature strongly suggests that child language performance varies with SES; however the pathways of mediation between SES and child language are unknown, and the degrees to which they reside in parent language or other parenting processes are yet to be determined. Gender has been consistently associated with child language performance, and so we also postulated a direct association between child gender and child language measures. Furthermore, we measured maternal verbal IQ in recognition of possible genetic associations between parent and child language abilities. Structural equation modelling allowed comparisons among alternative models that themselves offered interesting substantive interpretations. In the end, we identified a meaningful pattern of predictive relations that defined an integrative and interpretable set of direct and indirect pathways among endogenous and exogenous factors to children's vocabulary competence.

Child gender contributed directly to level of child language. As has been found previously, girls scored consistently higher than boys. Major reviews of the literature (e.g. Hyde & Linn, 1988) have similarly concluded that gender differences in verbal ability at an early age exist and favour girls, but are small in magnitude and may later attenuate. Sex-based differences in maturation might broadly affect early verbal capacities rather than different

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amounts of experience of daughters versus sons with language (Huttenlocher *et al.*, 1991; McCune, 1992).

Children's social competence related to their vocabulary competence. Among the three social subdomains in children measured by the VABS Socialization domain, interpersonal relationships and coping skills both related systematically to all six child language measures ($ps < 0{\cdot}05$); the play subdomain did not relate to any. Some questions on these two VABS subdomains tap vocabulary functioning (they ask, for example, whether the child can label happiness, sadness, anger, and fear in him/herself, imitate adult phrases, say 'please' when asking for something), and so it could be that the covariation between VABS Socialization and child vocabulary measures reflects measurement of common ability. However, social competence items on the VABS also evaluate the maturity of children's social skills APART from vocabulary (they ask, for example, about the child's imitation of complex tasks and ability to show affection). It could be, therefore, that children who show responsibility and sensitivity to others (children who score high in social competence) are highly verbal because they are more mature generally. Finally, it could be that these positive social characteristics are child effects, such that socially competent children elicit more or more effective vocabulary learning experiences from their parents and others. Although girls displayed greater language, and girls are on average more susceptible to early caregiving socialization regarding interpersonal skills than boys (e.g. Maccoby, 1988), social competence and gender were not related in this sample.

Mothers' vocabulary in conversation directly influenced their children's verbal comprehension and maternal reports of child vocabulary. These findings provide further evidence for the role of interpersonal verbal interaction in promoting child vocabulary (see Huttenlocher *et al.*, 1991). Building vocabulary in children requires time, energy, patience, and intellectual commitment on the part of parents, and young children appear to benefit from such direct conversational experience. Mothers' attitudes toward parenting – their self-reported competence, satisfaction, role balance, and social and didactic interaction styles – predicted child vocabulary competence. Parenting practices fall causally between self-evaluations on the one hand and child outcomes on the other. Parents' ideas about their own parenting may influence parenting behaviours or they may mediate the effectiveness of those behaviours, ultimately to affect child development (see Goodnow & Collins, 1990; Bornstein, 1995). Self-evaluations can exert direct effects on parenting practices or influence the relative effectiveness of parenting practices, or they could constitute important emotional climate variables both of which affect the child. For example, mothers who feel more competent in their role as parent might also be prone to engage their children in different (language stimulating) activities (Ninio, 1979). In short, self-

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evaluations and attributions influence parents through the affordance of organization and coherence to the tasks of parenting, and they help to influence children because they shape parenting behaviours.

Factors that predicted maternal vocabulary are noteworthy for themselves and because they indirectly influenced child vocabulary competence. Mothers who scored higher in verbal intelligence, mothers who knew more about child development, and higher-SES mothers addressed more different words in longer utterances to their children (see Hoff-Ginsberg & Tardif, 1995), and so these factors indirectly affected child vocabulary competence. Borduin & Henggeler (1981) claimed that differences in maternal language, sometimes interpreted as SES effects, could be attributable to differences in verbal facility. They found that mothers' WAIS and PPVT scores predicted their use of commands and questions better than SES, and argued that mothers' verbal facility explained the association between SES and other properties of mother-child interaction and child vocabulary. Hart & Risley (1992) also argued that family SES related to child vocabulary competence through maternal vocabulary. Our analyses suggest that SES and maternal knowledge and verbal IQ contribute independent variance to mothers' vocabulary and that each affected child language through maternal language. Maternal personality and attitudes toward parenting, as we measured them, did not exert any direct effects on maternal vocabulary or indirect effects on child vocabulary competence through maternal vocabulary. Perhaps maternal personality characteristics other than anxious sociability (for example, depression) would relate to child vocabulary competence, just as others kinds of attitudes toward parenting (for example, locus of control) could relate to child vocabulary competence. It is important to note that maternal personality and attitudes toward parenting did relate to child vocabulary competence indirectly through child social competence.

This multivariate ecological study of sources of child vocabulary competence is limited by the nature of the sample and the variables measured. Mothers who participated were all European American and primiparous, and children were all of a single age. Perhaps the determinants studied would be differently effective in predicting vocabulary competence in laterborn children or children of a different age or ethnic composition or in predicting features of child language other than vocabulary comprehension and expression as we measured them. Other characteristics of children, such as level of physical maturity (McCune, 1992) and information-processing ability (Bornstein, 1985), not measured here, doubtlessly contribute to predicting child vocabulary competence. Moreover, structural equation modelling does not demonstrate causal relations among variables, but rather evaluates support for hypotheses about causality – whether one model fits a data set better than another. Nonetheless, our findings indicate that mothers' vocabulary directed to 1;8-month-old typically developing children of normal,

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intact, middle-class families, along with their attitudes toward parenting and children's own gender and social competence, constitute significant proximal sources of developing vocabulary competence. In addition, the findings indicate that, considered in an ecological framework, mothers' SES, verbal intelligence, personality, attitudes toward parenting, and knowledge of child development constitute key determinants that also contribute indirectly to child vocabulary competence.

REFERENCES

Bates, E., Bretherton, I. & Snyder, L. (1988). *From first words to grammar*. New York: C.U.P.

Belsky, J. (1984). The determinants of parenting: a process model. *Child Development* **55**, 83–96.

Bentler, P. M. (1995). *EQS structural equations program manual*. Encino, CA: Multivariate Software.

Blake, J., Quartaro, G. & Onorati, S. (1993). Evaluating quantitative measures of grammatical complexity in spontaneous speech samples. *Journal of Child Language* **20**, 139–52.

Borduin, C. M. & Henggeler, S. W. (1981). Social class, experimental setting, and task characteristics as determinants of mother-child interaction. *Developmental Psychology* **17**, 209–14.

Bornstein, M. H. (1985). How infant and mother jointly contribute to developing cognitive competence in the child. *Proceedings of the National Academy of Sciences* (*U.S.A.*) **82**, 7470–3.

—— (1989). Between caretakers and their young: two modes of interaction and their consequences for cognitive growth. In M. H. Bornstein & J. S. Bruner (eds), *Interaction in human development* (197–214). Hillsdale, NJ: Erlbaum.

—— (1995). Parenting infants. In M. H. Bornstein (ed.), *Handbook of parenting* (Vol. 1, 3–39). Mahwah, NJ: Erlbaum.

Bornstein, M. H. & Tamis-LeMonda, C. S. (1995). Language and nonlanguage factors in development of prelinguistic vocalization to linguistic communication. In G. Konopczynski (ed.), *Is early language performance predictive of later language development?* (pp. 81–102). Calais, France: Ortho-Editions.

Bornstein, M. H., Tamis-LeMonda, C. S., Pascual, L., Haynes, O. M., Painter, K., Galperín, C. & Pêcheux, M.-G. (1996). Ideas about parenting in Argentina, France, and the United States. *International Journal of Behavioural Development* **19**, 347–67.

Bouchard, T. J., Lykken, D. T., McGue, M., Segal, N. L. & Tellegen, A. (1990). Sources of human psychological differences: the Minnesota study of twins reared apart. *Science* **250**, 223–8.

Breznitz, Z. & Sherman, T. (1987). Speech patterning of natural discourse of well and depressed mothers and their young children. *Child Development* **58**, 395–400.

Bronfenbrenner, U. & Crouter, A. C. (1983). The evolution of environmental models in developmental research. In W. Kessen (ed.), P. H. Mussen (series ed.), *Handbook of child psychology: Vol. 1. History, theory, and methods* (357–414). New York: Wiley.

Capron, C. & Duyme, M. (1989). Assessment of effects of socioeconomic status on IQ in a full cross-fostering study. *Nature* **340**, 552–4.

Cohler, B., Gallant, D., Grunebaum, H., Weiss, J. & Gamer, E. (1977). Attention, dysfunction, and childcare attitudes among mentally ill and well mothers and their young children. In J. C. Glidewell (ed.), *The social context of learning and development* (133–62). New York: Gardner-Wiley.

Crowne, D. P. & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology* **24**, 349–54.

Dunham, P. & Dunham, F. (1992). Lexical development during middle infancy: a mutually driven infant-caregiver process. *Developmental Psychology* **28**, 414–20.

https://doi.org/10.1017/S0305000998003456 Published online by Cambridge University Press

Dunn, L. M. & Dunn, L. M. (1981). *Peabody picture vocabulary test – Revised manual*. Circle Pines, MN: American Guidance Service.
Edwards, C. P. (1995). Parenting toddlers. In M. H. Bornstein (ed.), *Handbook of parenting* (Vol. 1, 41–63). Mahwah, NJ: Erlbaum.
Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J. & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development* **59** (Serial No. 242, No. 5).
Fenson, L., Thal, D. & Bates, E. (1990). *Normed values for the 'Early Language Inventory' and three associated parent report forms for language assessment* (Technical Report). San Diego: San Diego State University.
Goodnow, J. & Collins, W. A. (1990). *Development according to parents. The nature, sources, and consequences of parents' ideas*. London: Erlbaum.
Gottfried, A. W. (ed.). (1984). *Home environment and early cognitive development*. New York: Academic Press.
Hardy-Brown, K. & Plomin, R. (1985). Infant communicative development: evidence from adoptive and biological families for genetic and environmental influences on rate differences. *Developmental Psychology* **21**, 378–85.
Hart, B. & Risley, T. R. (1992). American parenting of language-learning children: persisting differences in family–child interactions observed in natural home environments. *Developmental Psychology* **28**, 1096–105.
Hernandez, D. J. (1997). Child development and the social demography of childhood. *Child Development* **68**, 149–69.
Hess, R. D., Kashiwagi, K., Azuma, H., Price, G. C. & Dickson, W. P. (1980). Maternal expectations for mastery of developmental tasks in Japan and the United States. *International Journal of Psychology* **15**, 259–71.
Hoff-Ginsberg, E. (1986). Function and structure in maternal speech: their relation to the child's development of syntax. *Developmental Psychology* **22**, 155–63.
—— (1991). Mother–child conversation in different social classes and communicative settings. *Child Development* **62**, 782–96.
—— (1995). The independence of communication and grammar in development. In D. MacLaughlin & S. McEwen (eds), *Proceedings of the Boston University conference on language development*. Somerville, MA: Cascadilla Press.
Hoff-Ginsberg, E. & Tardif, T. (1995). Socioeconomic status and parenting. In M. H. Bornstein (ed.), *Handbook of parenting* (Vol. 2, 161–88). Mahwah, NJ: Erlbaum.
Hollingshead, A. B. (1975). *The four-factor index of social status*. Unpublished manuscript, Yale University.
Hu, L.-T. & Bentler, P. M. (1995). Evaluating model fit. In R. H. Hoyle (ed.), *Structural equation modeling: concepts, issues, and application* (76–99). Thousand Oaks, CA: Sage.
Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M. & Lyons, T. (1991). Early language growth: relation to language input and gender. *Developmental Psychology* **27**, 236–48.
Hyde, J. S. & Linn, M. C. (1988). Gender differences in verbal ability: a meta-analysis. *Psychological Bulletin* **104**, 53–69.
Jackson, D. N. (1976). *Jackson personality inventory manual*. Goshen, NY: Research Psychologists Press.
LaFreniere, P. & Dumas, J. E. (1992). A transactional analysis of early childhood anxiety and social withdrawal. *Development and Psychopathology* **4**, 385–402.
Maccoby, E. E. (1988). Gender as a social category. *Developmental Psychology* **24**, 755–65.
MacPhee, D. (1981). *Manual for the knowledge of infant development inventory*. Unpublished manuscript, University of North Carolina.
MacPhee, D., Benson, J. B. & Bullock, D. (1986). *Influences on maternal self-perceptions*. Poster presented at the biennial International Conference on Infant Studies, Los Angeles, CA.
McCune, L. (1992). First words: a dynamic systems view. In C. A. Ferguson, L. Menn & C. Stoel-Gammon (eds), *Phonological development: models, research, implications* (pp. 313–336). Timonium, MD: York Press.

https://doi.org/10.1017/S0305000998003456 Published online by Cambridge University Press

Miller, J. F. & Chapman, R. S. (1993). *SALT : Systematic analysis of language transcripts*. Madison, WI: Language Analysis Laboratory, Waisman Center, University of Wisconsin.
Ninio, A. (1979). A naive theory of the infant and other maternal attitudes in Israel. *Child Development* **50**, 976–80.
—— (1980). Picture-book reading in mother–infant dyads belonging to two subgroups in Israel. *Child Development* **51**, 587–90.
O'Grady, K. E. (1988). The Marlowe-Crowne and Edwards Social Desirability Scales: a psychometric perspective. *Multivariate Behavioural Research* **23**, 87–101.
Paul, R., Looney, S. S. & Dahm, P. S. (1991). Communication and socialization skills at ages 2 and 3 in 'late-talking' young children. *Journal of Speech and Hearing Research* **34**, 858–65.
Reynell, J. & Huntley, M. (1985). *Reynell development language scales – second revision*. Windsor, England: NFER-Nelson.
Rollins, P. R., Snow, C. E. & Willett, J. B. (1996). Predictors of MLU: Semantic and morphological developments. *First Language* **16**, 243–59.
Smolak, L. (1987). Child characteristics and maternal speech. *Journal of Child Language* **14**, 481–92.
Snow, C. E., De Blauw, A. & Van Roosmalen, G. (1979). Talking and playing with babies: the role of ideologies of child-rearing. In M. Bullowa (ed.), *Before speech : the beginning of interpersonal communication* (269–88). Cambridge: C.U.P.
Sparrow, S. S., Balla, D. A. & Cicchetti, D. V. (1984). *Vineland adaptive behavior scales – Interview edition, Survey Form*. Circle Pines, MI: American Guidance Service.
Stevenson, M. B., Leavitt, L. A., Roach, M. A., Chapman, R. S. & Miller, J. F. (1986). Mothers' speech to their 1-year-old infants in home and laboratory settings. *Journal of Psycholinguistic Research* **15**, 451–61.
van IJzendoorn, M. H., Dijkstra, J. & Bus, A. G. (1995). Attachment, intelligence, and language: a meta-analysis. *Social Development* **4**, 115–28.
Vibbert, M. & Bornstein, M. H. (1989). Specific associations between domains of mother–child interaction and toddler referential language and pretense play. *Infant Behavior and Development* **12**, 163–84.
Weismer, S. E., Murray-Branch, J. & Miller, J. F. (1994). A prospective longitudinal study of language development in late talkers. *Journal of Speech and Hearing Research* **37**, 852–67.

https://doi.org/10.1017/S0305000998003456 Published online by Cambridge University Press