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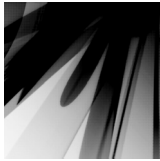
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## Early attention and literacy experiences predict adaptive communication

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### ABSTRACT

The present study investigated the contributions of sociodemographic factors, literacy experiences and child attention in predicting 2- to 5-year-olds' adaptive communication. In infancy, children participated in a habituation procedure, and length of their first look at a novel stimulus was used as an index of information processing. When children were 2–5 years of age, information about children's literacy experiences was gathered, and communication was assessed using the Communication Domain of the Vineland Adaptive Behavior Scales. Path analyses revealed direct effects for first look, reading per week and number of trips to the library for Adaptive Communication and the subdomain of Expressive Communication. Indirect effects of mother's education through first look, reading per week and child educational experiences also emerged. Path analyses revealed direct effects for amount of reading per week and number of trips to the library for the subdomain of Receptive Communication.

### KEYWORDS

Attention; communication; literacy; path analysis

## INTRODUCTION

Children in the first years of life develop the ability to communicate increasingly complex ideas through a combination of gestures and sounds (for reviews, see: Goldin-Meadow, 2006; MacWhinney & Bornstein, 2003; Waxman & Lidz, 2006). Of course children bring some of their own abilities to the task, but they do not achieve communication in isolation. Achieving effective communication also depends on a wide array of social, situational and linguistic supports. In this study we investigated the role of several specific child and family factors in predicting individual variation in adaptive communication in early childhood.

We focused on children's general adaptive communication because we were concerned with children's use of language in context. Adaptive behaviors include a range of everyday communication, socialization, living and motor skills, and adaptive behavior is conceptualized as the effectiveness with which individuals actively cope with the demands of their natural and social environments (Emery, 1999; Herber, 1961; Lazarus, 1999; Scarr, 1996). Adaptation is fundamental to successful growth and development and is achieved through the organism's interactions with its immediate environment. Thus, the development of adaptive behaviors takes place in context.

To measure children's adaptive communication, we chose the Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla & Cicchetti, 1984). The parent is asked (in the structured VABS interview) to rate the child's typical behaviors across a variety of contexts. By interviewing the parent, the child's adaptive use of language is assessed from someone who knows the child best and is familiar with the child's daily habits. The VABS interview focuses on overt and concrete behaviors and developmental milestones that are obvious and that parents are likely to notice (e.g., 'addresses at least two familiar people by name'). There is high level of agreement between the VABS Communication Domain and other measures of linguistic competence such as observations and experimenter assessments of child language performance (Bornstein & Haynes, 1998).

The present study was designed to investigate the contributions of child factors, children's literacy experiences and sociodemographic variables in predicting their adaptive communication. To organize our inquiry, we drew on the ecological framework that includes concurrent factors contributed by the environment, the parent and the child (e.g., Fletcher & Reese, 2005). This model considers each domain of possible contributors in terms of their distal-to-proximal relation to the child (see Bronfenbrenner & Morris, 1998). One set of influences on communication development are the sociodemographic characteristics of the family (e.g., maternal education; hours mothers work). More proximal influences on children's communication development may be recent literacy experiences, and they are likely to change as greater competency is achieved. Finally, children bring their own endogenous characteristics to their communication development. The introduction that follows briefly explores rationales underlying the selection of measures at each ecological level in terms of their potential associations with young children's communication.

## Sociodemographic factors

The first set of factors are sociodemographic variables – maternal education, maternal employment and child gender. Maternal education has been shown to account for a portion of the variance in cognitive assessments in children, such as school readiness, vocabulary and IQ (e.g., Castro, Lubker, Bryant & Skinner, 2002; Feldman et al., 2000; Fewell & Deutscher, 2003). Less is known about the influence of maternal employment on children's communication development, and the findings to date are mixed. For example, Brooks-Gunn, Han & Waldfogel (2002) found a negative association between maternal employment in the child's first year of life and school readiness at age 3; Ruhm (2004) reported reduced verbal scores in 3- and 4-year-olds whose mothers worked; and Smith (1995) documented a negative relation between maternal employment in the child's first year of life and reading development at age 7. Youngblut et al. (2001), however, suggest that the effects of maternal employment may be overstated, as they found little effect of maternal work on 3- to 5-year-olds' vocabulary development. By assessing maternal work we hoped to contribute to this literature. The final sociodemographic variable was child gender. It is often reported that girls exceed boys in areas of language and adaptive communication (e.g., Bornstein, Giusti, Leach & Venuti, 2005; Bornstein, Hahn & Haynes, 2004; Bornstein & Haynes, 1998), but the structure and organization of language in boys and girls is still under debate, and so we consider gender in this study as well.

## Children's literacy experiences

One predictor of children's communicative development is the amount and diversity of input young children receive (Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991). A principal source of this input comes from adults reading to children. Children's exposure to story books normally begins well before the age of 3, and this exposure normally increases during the early years. In one study sampling over 2500 families, 66.7% of parents reported reading between three times per week to every day to children from birth to 3 years of age (Bradley, Corwyn, McAdoo & Garcia Coll, 2001). Numerous studies have documented the effects of book reading, by parents and teachers, on vocabulary or receptive language development in young children (e.g., DeTemple & Snow, 2003; Neuman, 1996; Senechal, LeFevre, Hudson & Lawson, 1996; Stahl, 2003; Wasik & Bond, 2001), although the magnitudes of effects are variable and typically modest. For example, 18% of the variance in different measures of children's language and literacy development was accounted for by parent-child reading experience (reported by Scarborough & Dobrich, 1994, in their review of three decades of research). In addition, Payne, Whitehurst & Angell (1994) found a composite literacy score to account for 12–18% of the variance in children's vocabulary scores. Few, if any, studies have addressed the effects of literacy experiences on adaptive communication, however.

We selected several measures in an attempt to capture children's literacy experiences: amount of reading to the child by an adult, number of trips to the library and amount of formal education the child had experienced. Amount of reading has

traditionally been used to measure one aspect of a child's exposure to language and new vocabulary (e.g., DeTemple & Snow, 2003; Senechal et al., 1996); however, we also included number of trips to the library and amount of formal education to index children's literacy environments more broadly (e.g., Marcon, 1992; Payne et al., 1994; Rodriguez, Diaz, Duran & Espinosa, 1995; Soderberg & Howard, 1969; Stahl, 2003).

## Child factors

The third type of factor we considered was characteristics of the child. There is a recognized dearth of knowledge about how children direct their own exposure to language (van Kleeck, 2003). The few studies that have examined child factors have focused on what the child does during reading interactions, such as the child's interest in books, responsiveness to questions and/or attention during story book reading (e.g., van Kleeck, Alexander, Virgil & Templeton, 1996). It is likely that some child characteristics, namely information-processing skills, contribute to children's adaptive communication. These more general cognitive factors are not specific to communication, but they may play a role in facilitating the linguistic experiences young children receive. Information-processing abilities vary among children, and this variability is present in early infancy (for reviews, see: Bornstein, 1989; Colombo & Fagan, 1990).

Information-processing variables in infants, often assessed via measures of looking or inspection time, have proven valid predictors of future cognitive performance (e.g., Bornstein, 1985; Bornstein et al., 2006; Colombo & Frick, 1999). In a review of the literature, Slater (1995) reported a correlation of 0.42 between information processing at 4–7 months of age and measures of cognitive ability in children aged 1.5–6 years. In a 4-year longitudinal study, Bornstein et al. (2006) found predictive validity from infant looking to cognitive abilities at age 4. In this study, we used length of first look to a novel stimulus as an index of infant information processing. One predictor of an efficient information processor is looking or attending to a stimulus the first time it is presented (Colombo & Mitchell, 1990). Sternberg's (1985) Triarchic Theory of Intelligence, for example, casts as central to understanding intelligence the efficient application of information-processing skills to novelty, alongside the mental processes that underlie intelligent behavior and adaptation to the environment.

## Present study

In the present study, children's information-processing abilities were assessed in a laboratory task using visual stimuli in one visit between the ages of 3 and 9 months. The families were contacted again when the children were between 2 and 5 years of age, and information was collected about the demographics of the family, the child's literacy environment and adaptive communication. Path analyses were used to identify direct and indirect influences of sociodemographic variables, children's literacy experiences and child factors on measures of adaptive communication.

## METHOD

### Participants

The sample consisted of 229 children (117 girls), tested once as infants and then assessed once between 2 and 5 years of age. Families were recruited through the use of purchased mailing lists of newborns. Infants were a mean age of 183 days ( $SD = 49.29$ ) and were tested at one of four ages: 3, 5, 6 or 9 months. Families were contacted again when their children were 2–5 years of age ( $M = 4.0$  years,  $SD = 0.89$ ). The majority of children were European American, with less than 10% of the sample being infants of African, Asian or Latin American heritage. In the sample, 150 children were firstborn, and there were, on average, 2.05 ( $SD = 0.79$ ) children in the home at the time of the communication assessment. The families were from predominantly middle to upper socioeconomic status households ( $M = 57.0$ ,  $SD = 8.7$ , on Hollingshead's (1975) Four-Factor Index of Social Status; see Bornstein, Hahn, Suwalsky & Haynes, 2003).

### Materials, apparatus and procedures

#### *Communication assessment*

Parents were interviewed by telephone using The Interview Edition, Survey Form of the Vineland Adaptive Behavior Scales (VABS; Sparrow et al., 1984). The Communication Domain of the VABS provides measures of expressive (production), receptive (comprehension) and written communication, and a composite score for adaptive communication (a standardized summed score of expressive, receptive and written communication,  $M = 100$ ,  $SD = 15$ ). This interview assesses the child's performance, not ability, as evaluated and reported by a parent to a trained interviewer. Of the 67 items pertaining to Communication, scores reflected whether or not the child performed the activity described. A score of 2 indicates 'yes, usually', 1 'sometimes or partially' and 0 'no, never'. On the Survey Form, scores could also indicate that the child had no opportunity to perform the activity (*N*) or that the parent did not know whether the child performed the activity (*DK*). All language scores were adjusted for child's age. Overall adaptive communication scores were obtained from tables of nationally standardized age normed scores. Expressive and receptive scores were adjusted for age by entering the child's age into regression analyses predicting language scores, saving the unstandardized residuals and adding the mean of the unstandardized score to the residuals (to restore the metric of the original variables).

#### *Sociodemographic information*

Demographic information (child gender, family socioeconomic status) was collected with a questionnaire. Items included highest level of education for each adult currently living in the household and number of hours mother worked per week.

#### *Literacy*

Literacy information included questions about the frequency of adult reading to the child in the past week (never, once or twice, every other day, almost every day,

every day, more than once a day), the number of trips to the public library per year (obtained by asking about number of times per month and multiplying by 12), and number of months of child formal education outside the home (e.g., in preschool, Montessori or kindergarten).

### *Infant information-processing assessment*

The stimuli were static full-color images of animals, vehicles and a smiling female face, or black-and-white dynamic point-light displays of animals and vehicles (for more detail, see: Arterberry & Bornstein, 2001; Arterberry & Bornstein, 2002; Bornstein & Arterberry, 2003). The measure of infants' information processing was the duration of *first look* infants gave to the stimulus, as measured by corneal reflection by an experimenter. Despite variation in duration measures across infants, these measures are reliable within infants across short and long periods of time (1 week to 3 months; e.g., Colombo, Mitchell, O'Brien & Horowitz, 1987), thus providing a reasonably stable indicator of individual differences in information processing. To obtain a measure of coding reliability, a second experimenter also scored infant looks, either during the testing session or at a later time from the video record. Intercoder agreement was obtained for 76% of the infants;  $r = 0.98$ .

## RESULTS

Univariate distributions for all variables were checked for normalcy and homogeneity of variance, and bivariate plots for outliers (Fox, 1997). Four participants were excluded from analyses because their language scores fell more than 3 *SDs* above the mean.

Table 1 contains the means and standard deviations for the three communication measures and for the sociodemographic, literacy experience and infant information-processing variables. Because the children varied in age at the second testing, we also include child age (in months). Children's communication scores fell within the normal range for their age. Table 1 also shows the inter-correlations among the measures. As expected, the three communication measures were highly correlated. In addition, significant correlations were found between the communication variables and the socio-demographic, literacy experience and infant information-processing variables, with one notable exception. Maternal education, while showing relations to some literacy experiences, was not significantly correlated with the communication measures. Child age was significantly related to overall adaptive communication, child formal education and first fixation. The correlation between child age and overall adaptive communication was surprising, and this was probably due to the fact that the standard procedure for adjusting scores for age was not fully adequate for our sample.

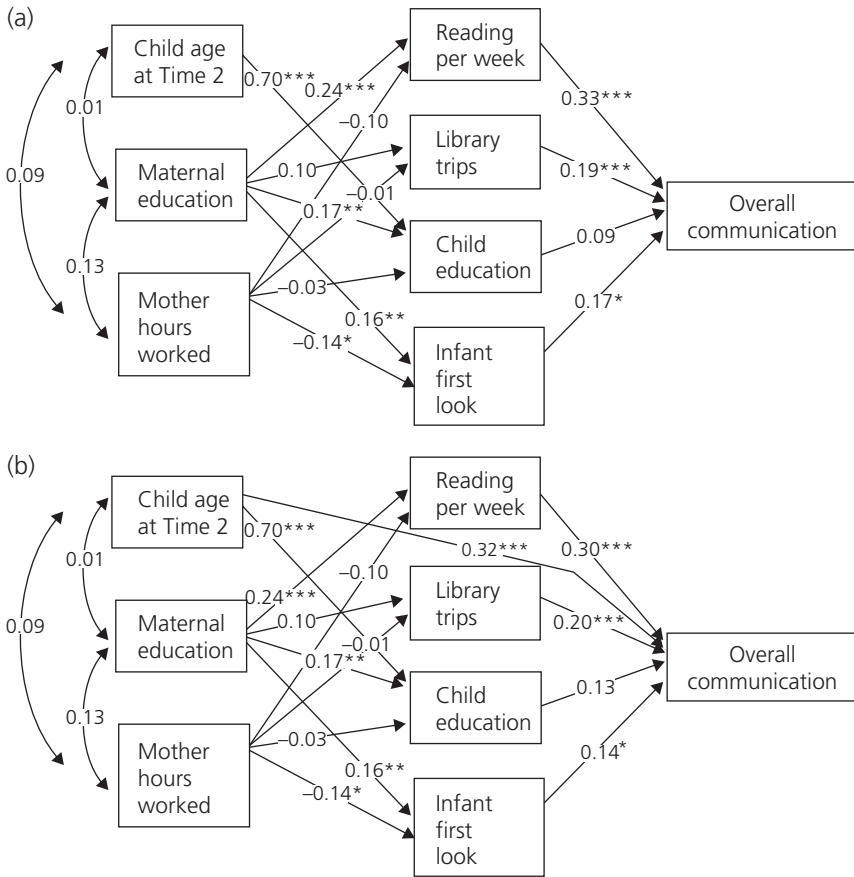
Path analyses were conducted to evaluate the utility of the model illustrated in Fig. 1a for overall adaptive communication, expressive communication and receptive communication. Analyses were conducted using LISREL 8.72 with robust estimation. For overall adaptive communication, the model did not fit,  $\chi^2(12) = 23.18$ ,  $p = 0.026$  ( $\chi^2$  corrected for non-normality), and modification indices suggested a direct path from child age to overall communication. The revised model is illustrated

**Table 1** Means, standard deviations and correlations of 2- to 5-year-olds' communication, sociodemographic, literacy experiences and infant information-processing variables (N = 225)

Variable	M	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Communication												
1. Adaptive total	103.35	11.54	-	0.86**	0.41**	-0.28**	-0.15*	0.09	0.30**	0.23**	-0.11	0.25**
2. Expressive	46.48	5.29	-	-	0.39**	-0.01	-0.20*	0.08	0.26**	0.18**	0.12	0.23**
3. Receptive	24.23	0.76	-	-	-	0.00	-0.15*	-0.06	0.16*	0.15*	0.02	0.18**
Sociodemographic variables												
4. Child age (months)	48.65	10.76	-	-	-	-	0.09	0.01	-0.11	-0.06	0.70**	-0.14*
5. Maternal work (hours)	19.15	18.80	-	-	-	-	-	0.13	-0.07	0.00	0.06	-0.12
6. Maternal education (years)	16 years+	-	-	-	-	-	-	-	0.23**	0.10	0.18**	0.16*
Literacy experiences												
7. Adult reads	Every day+	-	-	-	-	-	-	-	-	0.06	0.02	0.17**
8. Trips to library (yearly)	19.89	19.92	-	-	-	-	-	-	-	-	-0.01	0.11
9. Formal education (months)	10.77	9.50	-	-	-	-	-	-	-	-	-	-0.07
Information processing												
10. First look (seconds)	16.29	9.51	-	-	-	-	-	-	-	-	-	-

\* $p < 0.05$ , \*\* $p < 0.01$ .

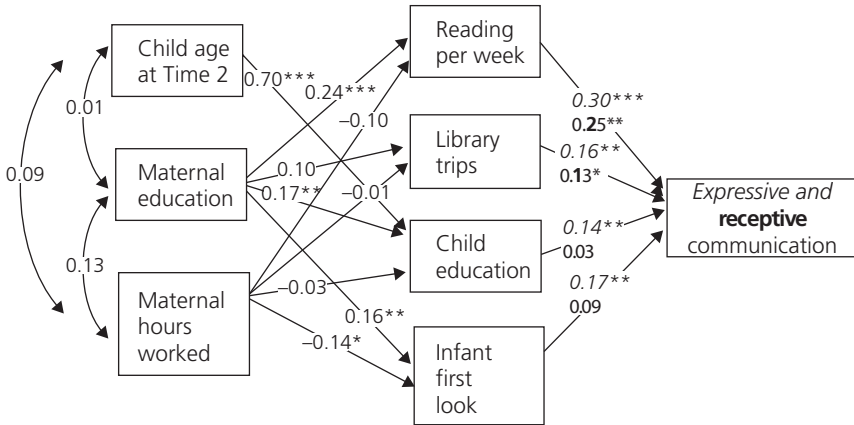




**Figure 1** Two models for path analyses for overall adaptive communication; the model in (a) did not fit the data, but that in (b) did. Values reflect standardized path coefficients. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

in Fig. 1b, and the analyses revealed that the model fitted the data,  $\chi^2(11) = 11.71$ ,  $p = 0.39$  ( $\chi^2$  corrected for non-normality). Fit indices supported this determination: the CFI was 0.98, RMSEA was 0.047, the 90% CI was 0.00–0.09, the GFI was 0.98, and the AGFI was 0.94. Significant direct effects emerged for reading per week, number of library trips per year and infant first look on communication (see Fig. 1b). The analyses also revealed significant indirect effects for maternal education (standardized coefficient = 0.14,  $p < 0.001$ ) through child reading per week, child education and infant first look. This model held for boys and girls separately, difference  $\chi^2(14) = 16.14$ ,  $p = 0.30$ .

For expressive communication, the path analysis revealed that the original model fitted the data (see Fig. 2),  $\chi^2(12) = 14.88$ ,  $p = 0.25$  ( $\chi^2$  corrected for non-normality). The CFI was 0.96, RMSEA was 0.055, the 90% CI was 0.00–0.10, the GFI was 0.98, and the AGFI was 0.93. As shown in Fig. 2 (italicized coefficients), reading per



**Figure 2** Path analyses for expressive communication (*italicized*) and receptive communication (**bold**); paths among mother education, mother work, reading per week, library trips, child education and infant first look did not vary. Values reflect standardized path coefficients. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

week, number of library trips per year, child education and infant first look had significant direct effects on expressive communication. Maternal education had significant indirect effects on expressive communication (standardized coefficient = 0.14,  $p < 0.001$ ) through child reading per week, child education and infant first look. This model also held for boys and girls separately, difference  $\chi^2(13) = 13.83$ ,  $p = 0.39$ .

For receptive communication, the path analysis revealed again that the original model fitted the data,  $\chi^2(12) = 13.83$ ,  $p = 0.31$  ( $\chi^2$  corrected for non-normality). The CFI was 0.96, RMSEA was 0.050, the 90% CI was 0.00–0.09, the GFI was 0.98, and the AGFI was 0.93. Unlike the analyses for overall adaptive communication and expressive communication, however, only reading per week and number of library trips per year had significant direct effects on receptive communication, and there were no significant indirect effects on receptive communication (see Fig. 2, bold coefficients). This model also held for boys and girls separately, difference  $\chi^2(13) = 12.09$ ,  $p = 0.52$ .

## DISCUSSION

The purpose of this study was to investigate the contributions of sociodemographic variables, literacy experiences, and child factors on adaptive communication in young children. Path analyses revealed direct and indirect effects of amount of reading per week, the number of library trips per year, child education, infant attention and maternal education. Although the ecological model was appropriate for all three measures of communication – overall adaptive communication, expressive communication and receptive communication – slightly different patterns of effects were found for each measure. Moreover, we found that each model held for boys and girls.

Reading to children and trips to the library showed direct effects on all three measures of adaptive communication. The link between reading to children and communication is consistent with other research that shows a relation between adult reading to children and children's vocabulary development (e.g., DeTemple & Snow, 2003; Senechal et al., 1996). The shared reading context provides numerous opportunities for learning language and communication skills. For example, van Kleeck et al. (1996) documented that mothers of children between 6 and 12 months spend a lot of time engaging their children in books during shared reading sessions. Also, the quality of conversation during book reading has a higher level of abstraction than other types of play interactions (Sorsby & Martlew, 1991). Others have found that the manner in which books were read, such as amount of repetition and the types of questions asked during reading interactions, also facilitates language acquisition (e.g., Senechal, 1997; Wasik & Bond, 2001). Although trips to the library have been used to assess children's literacy environments globally, along with number of books, recognition of titles of children's books by parents and the like (e.g., Payne et al., 1994), the independent influence of trips to the library in facilitating communication has not been previously documented.

When we initially questioned parents about trips to the library, we did not operationalize this variable for them. To gain further understanding about what it means to 'go to the library', we asked twenty parents whose children were between the ages of 1 and 5 years to elaborate for us what trips to the library entail and their goals for taking their children to the library. Trips to the library involve exposure to printed materials (parents reading to their children in the library, discussions about books, story time) but they include additional activities that may also foster communication. Parents reported that these trips afford interactions with unfamiliar adults (e.g., librarians, parents of other children) and the opportunity to engage with unfamiliar children while exploring books, puzzles, puppets and other toys. Several parents said that their goals for these trips included an appreciation for books, seeing other children and parents reading together, encouraging warm associations with libraries and, as one parent said, 'We want our children to enjoy reading and explore new ideas.' Given the independence of trips to the library from the amount parents read to children, it is unlikely that trips to the library is a simple proxy for adult reading to children. Trips to the library provide young children with opportunities for a wider range of experiences, in addition to exposure to a greater variety of forms of print media.

Information-processing skills, as indexed by infants' first look at novel stimuli, had a direct effect on overall adaptive communication and expressive communication in 2- to 5-year-olds. When considering children's contributions to directing their literacy experiences, researchers have focused on attention during story book reading or how engaged children are in an interactive activity (e.g., Senechal, Cornell & Broda, 1995; Sulzby, 1985; van Kleeck et al., 1996). Mothers' efforts at focusing younger children's attention towards a book during a shared reading task predict language skills in 1-year-olds (Karrass, Braungart-Rieker, Mullins & Lefever, 2002). Our finding suggests that, even before significant exposure to reading materials, long-term and stable individual differences in information processing may impact the extent to which children can take advantage of the literacy environment created by parents, care providers and teachers.

Maternal education exerted an indirect effect through reading per week, child education and infant first look for overall adaptive communication and expressive communication. The link between maternal education and language has been well documented (e.g., Fewell & Deutscher, 2003), as have other dyadic behaviors (Bornstein et al., 2003); however, in this study we found that the effect is indirect, and it does not hold for all measures of communication.

Child educational experiences had a direct effect only on expressive communication. The relation between early childhood education and language development is not a new finding (e.g., Marcon, 1992; Rodriguez et al., 1995; Soderberg & Howard, 1969); however, we found it only held for expressive communication, unlike others who have found gains in receptive vocabulary (Soderberg & Howard, 1969) or both receptive and expressive language (Rodriguez et al., 1995). Gains in adaptive communication may be particularly sensitive to the early childhood educational environment; Marcon (1992) found that early childhood programs that allow children to direct their focus of learning produced greater gains in adaptive skills, including adaptive communication, than programs that had a mix of child- and teacher-initiated learning.

Few studies have measured both receptive and expressive language or communication as we did; however, those that have explored these characteristics separately have reported differential effects, as we found in the present study. In a study of 1-year-olds, Karrass & Braungart-Rieker (2005) found effects of shared book reading for expressive language, but not receptive language, as measured by the language items on the Bayley Mental Scale and the Sequenced Inventory of Communicative Development – Revised, Expressive and Receptive scales. Similarly, Senechal (1997) found differential effects of book reading styles for 3- and 4-year-olds' expressive and receptive vocabulary: children's listening to multiple readings of a book influenced both receptive and expressive vocabulary, whereas, their answering questions facilitated expressive vocabulary more than receptive vocabulary. In the present study, we found differential patterns of results for 2- to 5-year-olds' receptive and expressive communication as measured by the VABS. Although our ecological model fitted all three measures of communication, direct and indirect factors varied for the three communication measures. The results of the previous studies, combined with the present findings, suggest different pathways for acquisition of expressive and receptive language and communication in young children. These findings suggest that future research should measure both aspects of language or communication.

The variables used in our models accounted for independent sources of variance in children's adaptive communication. The relative independence of variables lends support to Fletcher & Reese's (2005) framework for conceptualizing relations between story book reading and language development. They focus on concurrent factors contributed by the parent (e.g., SES, gender), the child (e.g., language, attention), and the book (e.g., frequency, type). In the present study, we focused on factors related to mother, literacy experiences and the child, and we found that each had direct or indirect paths to adaptive communication, supporting the view that asserts direct and indirect distal and proximal sources of influence in child development (Bronfenbrenner & Morris, 1998).

Our findings have implications for policy and interventions for promoting development of adaptive communication in young children, and they highlight the need for

family-focused, rather than only child-focused, intervention strategies. Encouraging reading in children, along with trips to the library, are likely to have the strongest impact in fostering both expressive and receptive communication, at least in families of middle to high SES. Future questions may address whether the same patterns hold for children from a wider range of socioeconomic groups, in the light of differences found between children's home environments and poverty status (e.g., Bradley et al., 2001).

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