Partners: A Curriculum to Help Premature, Low Birthweight Infants Get Off to a Good Start

Joseph Sparling and **Isabelle Lewis,** *University of North Carolina at Chapel Hill,* **Craig T. Ramey,** *University of Alabama at Birmingham,* and **Barbara H. Wasik, Donna M. Bryant,** and **Lisa M. LaVange,** *University of North Carolina at Chapel Hill*

Partners, a curriculum emphasizing adult–child interactions, or partnering, was developed in the mid-1980s at the Frank Porter Graham Child Development Center and was first used in the Infant Health and Development Program, a 3-year longitudinal intervention study in eight cities that involved premature, low birthweight (LBW) infants. The first part of the curriculum, called *Early Partners,* emphasizes factors that are of particular salience in the development of LBW children. *Early Partners* and the second part of the curriculum, called *Partners for Learning,* include 23 developmental skills organized into four broad themes. A multiple regression analysis showed that measures of the rate at which the curriculum was delivered, both in the child development center and in the home, added significantly to the prediction of 36-month Stanford Binet IQ. A descriptive analysis revealed an IQ advantage (13 IQ points for "lighter" LBW children and 6 IQ points for "heavier" LBW children) associated with receiving an average rather than a low quantity of curriculum activities in the child development center.

Premature (< 37 weeks gestational age), LBW (< 2,500 g) infants (see Note 1) are at risk for reduced performance in cognitive development (McBurney & Eaves, 1986; McCormick, 1985), behavioral adjustment (Field, Dempsey, & Shuman, 1979), and school achievement (Scott, 1987). LBW infants constitute a sizable group, about 250,000 annually in the United States (Statistical Abstracts of the

United States, 1990), and are born to families in all walks of life. However, young maternal age (National Center for Health Statistics, 1982), low family income and educational level (Committee to Study the Prevention of Low Birthweight, 1985), parental anxiety, and reduced parent–child interaction (Bidder, Crowe, & Gray, 1974; Minde, Marton, Manning, & Hines, 1980) are overrepresented in families of LBW infants. These family characteristics, in combination with LBW child characteristics, gave impetus to our belief that we needed a curriculum tailored to the parents and caregivers of LBW babies; consequently, we developed the *Partners* curriculum. In the initial use of this new curriculum, we resolved to study the association between curriculum implementation and intervention outcome, because that relationship is rarely investigated. The initial findings of our research, using data from the Infant Health and Development Program (IHDP), are reported here. A second curriculum in the IHDP intervention was designed to enhance the problem-solving behaviors of parents (Wasik, 1984) but is not analyzed or reported in this article.

Early Partners

Early Partners (Sparling, Lewis, & Neuwirth, in press), the first portion of the curriculum, is designed to support parent–child interactions in the first anxious months after the premature child comes home from the hospital. *Early Partners* is presented on 26 illustrated cards and is accompanied by a manual for the home visitor who delivers the curriculum.

Although most babies born prematurely do eventually develop all the skills of full-term babies, some significant early differences in motor, social, and cognitive behaviors are the target areas for the *Early Partners* curriculum. These early behaviors are related to (a) cues from the baby, (b) sleep/awake states, (c) calming, (d) levels of stimulation, (e) interaction and communication, (f) muscle tone, (g) eye–hand coordination, and (h) independent handling and manipulation.

Cues from the LBW baby in the first months of life may be harder for the parent to read than the lusty cries, ready smiles, and energetic kicks of the full-term child. The *Early Partners* curriculum encourages parents to believe that their LBW baby *is* communicating her needs and feelings, even though the cues may be weaker or in some way different from the norm. The goal of these activities is to free the parent

to relax, notice, and enjoy the child. Careful observation helps the parent become a more effective partner, one who accepts and understands the LBW baby's range of behaviors and knows how to respond in ways that meet the baby's needs. To reach this and other goals, the curriculum uses the technique of showing cartoon illustrations of adults who are experiencing the joys and frustrations of parenting a LBW child. The illustrations include the adults' thoughts, language, and decisions.

Sleep/awake states are fairly clear in the full-term newborn, but a very young premature baby at first has little control over staying awake. *Early Partners* helps parents understand that their LBW baby may shift rapidly and unpredictably between being asleep, drowsy, calm, or upset. Understanding that this is normal for premature babies can improve the parents' attempts to socialize with their baby and reduce the chance that they will take it personally if their baby becomes fussy or falls asleep even while they cuddle and play with him.

Calming the premature child may require an extra measure of skill and patience from the parent. While some preemies seem apathetic and hard to rouse, others are sometimes irritable and slow to be soothed or calmed. Calming techniques, such as swaddling, are illustrated in *Early Partners*. Pictured on one card is a mother helping her crying baby to get his thumb into his mouth so he can comfort himself. Models of this sort give the home visitor and the parent of a LBW baby a basis for discussion and planning.

Levels of stimulation must be appropriately gauged by the parent of a preterm baby. Through the *Early Partners* portion of the curriculum, new parents learn that their premature baby thrives, like all children, on her parents' loving attention. But children who were born prematurely seem to quickly reach their limit of how much sensory information they can handle. To protect herself, the preemie may look away, turn her head, yawn, tense her limbs, arch her back, grimace, or even fall asleep. Some of the activity cards help parents understand that these are ways the baby tries to release tension and take a short break when play or other activities become too stimulating. Many of the cards model how to be aware of levels of stimulation and how to respond when things seem to be a little overwhelming for the LBW child.

Interaction and communication are best when parents of premature infants pay close attention to two of the previously mentioned target areas of the curriculum: infant cues and levels of stimulation. The curriculum contains many cards that show how to interact and

communicate with the preemie by responding to the cues the baby provides and by adjusting the adult's response so that the level of stimulation is appropriate to the moment. The home visitor is able to use these cards to point out that the preemie, from birth, is communicating, and that it just takes some extra calmness and sensitivity to be his social partner. To foster the parent's attention to and understanding of the baby's messages, the cards encourage the parent to talk aloud for the baby, expressing what his cues and signals seem to mean.

Muscle tone is the basis for another target area of the *Early Partners* curriculum. Preemies are not born looking chubby and dimpled like the infants in baby food ads. Premature newborns often look scrawny and shriveled. Not only are their bones and body parts smaller, but they lack body fat and the familiar full-term degree of muscle tone. The curriculum cards attempt to reassure parents by including illustrations of babies with limp muscles and offering a number of suggestions on early positioning that can keep the baby's muscles from becoming used to awkward positions. For example, a baby placed on its back is shown with rolled towels on each side propping thighs, knees, and shoulders toward the front of its body. Side lying is encouraged through the cartoon illustrations, as well as holding or cuddling positions that compensate for low muscle tone.

Eye–hand coordination is the skill that allows moving the fingers, hands, and arms smoothly to perform a visually guided task. A baby who is born early does develop eye–hand coordination, of course, but to do so, she must be able to watch herself move her hands and fingers. The curriculum cards remind parents to prop the shoulders and arms forward, especially when the child is held on the adult's lap. Other games show how the child's arm can be prompted to come forward in a reaching motion, and how all this propping and reaching can be fun for parent and child.

Independent handling and manipulation, the final target area of the curriculum, is particularly important when the child reaches 6 to 12 months of age. At that time, preemies, like all children, become more interested in exploring and manipulating objects in new ways, but fine motor development may lag behind mental and social abilities. The parent using the *Early Partners* curriculum learns a number of games and activities to counteract this motor lag and reduce the infant's frustration that may arise when his manipulative skills keep him from carrying out some of his ideas. For example, in games where the child touches the mother's face, she might at first reduce the need to reach out accurately by leaning in close to the baby's hand. This

approach, of offering a little start-up help and then moving toward greater independence, is a pattern that is carried over to the more complex activities of the *Partners for Learning*.

Partners for Learning

The second part of the curriculum, *Partners for Learning* (Sparling & Lewis, 1984b, in press), overlaps *Early Partners* but continues to age 36 months, supporting the interactions of the parent–child dyad at home and the caregiver–child dyad in a day care program. *Partners for Learning* was designed for full-term infants, but provides an appropriate follow-up for preterm infants who begin with *Early Partners*.

The cards that present the curriculum contain simple text and cartoons that are color-coded to indicate specific developmental-age periods. The curriculum is designed to be delivered in the home by a home visitor or to be used by a teacher/caregiver in a day care center. Our advice to the home visitor is to avoid, whenever possible, demonstrating the curriculum games and activities. The home visitor's goal is to help the mother and other home caregivers to develop confidence and skill. It is far more effective to help the parent carry out the game than to show him or her how.

Both parts of the *Partners* curriculum have four basic features: (1) *Game-like learning activities* enable easy assimilation by day care staff members, home visitors, and parents. Each game is presented on one of the curriculum activity cards. These "bite-sized" bits are not as daunting as other, less differentiated presentations of curriculum—and they are fun. (2) *Cycles of use* (2 weeks is the suggested length of time) allow the parent or teacher to use several games frequently for a while but also to maintain the child's interest by soon moving on to something new. Still, the period of use is long enough to allow for all aspects of good practice, including observation, implementation, and assessment. (3) *Integration* into daily life makes the "curriculum" feel natural and comfortable in the home or center. The curriculum activities enrich care routines such as diapering, feeding, dressing, and special one-to-one times. (4) *Specific skills for children* in the curriculum activities provide for clarity and immediate utility, while *general principles* gradually enable the parent or teacher to gain a deeper understanding of an instructional model for early education.

With this understanding the adults can appreciate their own important contribution to the curriculum and can begin to create variations and new activities.

The games and activities for children cover a full spectrum of developmental skill areas, 23 in total. The areas, organized into four broad themes, are listed in Table 1. The skill areas are further divided into skill goals, each related to one of the 26 specific learning activities of *Early Partners,* to one of the 200 specific learning activities that make up the birth to 24-month *Partners for Learning* kit (Sparling & Lewis, 1984b), or to one of the 100 specific activities that make up the 24- to 36-month *Partners for Learning* kit (Sparling & Lewis, in press).

An instructional model is included in the *Partners* curriculum and is organized around seven principles, familiarly called "adult skills." If these are present in the adult's behavior, he or she typically finds it easy to think of variations and improvements on the suggested child learning activities and to invent new activities throughout the day. The adult skills (or general principles) are the following:

1. To *prepare* the materials and ideas necessary for child learning activities.
2. To *attend* to the child's behaviors that reveal his or her learning status.
3. To *model,* through adult behavior, appropriate language and problem solving.
4. To *support,* with smiles and praise, steps the child takes toward mastery.
5. To *prompt* the child's most appropriate behavior (making it likely to happen).
6. To *rescue* the child by revising a task that is too difficult.
7. To *build* by adding challenging elements to a task the child has previously completed.

In aggregate, these skills describe the adult's behavior as she or he effectively becomes a partner with a young child. The adult–child transaction is of particular developmental importance. *Partners* emphasizes adult-mediated aspects of the educational process in the first years of life, especially the language with which an adult surrounds an activity—perhaps the most powerful tool of mediated learning (McGinness & Ramey, 1981).

In summary, *Partners* can be described as a two-part curriculum that is cyclic, is game-like, is integral to home and day care, covers

Table 1. Child Skills in *Partners for Learning*

Broad themes	Specific skill areas
	1. Awareness of object permanence
	2. Awareness of positions in space
Cognitive	3. Puzzle skills
and	4. Sorting skills
Fine Motor	5. Matching skills
	6. Awareness of cause and effect
	7. Sensory awareness
	8. Awareness of self image
Social	9. Skills in sharing with an adult
and	10. Skills in interacting with other children
Self	11. Skills in imitating gestures
	12. Self-help skills
	13. Awareness of needs and feelings
	14. Rhythm skills
Motor	15. Balance skills
	16. Skills in throwing/pushing/pulling
	17. Dialogue skills
	18. Skills in using books
Language	19. Skills in talking about picture–object pairs
	20. Skills in talking about concept pictures
	21. Skills in talking about action pictures
	22. Skills in talking about object pictures
	23. Skills in talking about relationship pictures

23 child development areas, promotes seven generalizable adult skills, and is biased toward adult–child transactions involving language. *Partners for Learning* acts as both a child curriculum and a staff development resource. It contains all of the materials needed for implementation (special toys, pictures, record sheets, etc.), and its simple reading level and cartoons make it easy to use for most adults.

Previous Evidence of Efficacy

The *Partners* curriculum is a second-generation product based on the demonstrated efficacy of *Learningames,* an earlier curriculum developed by Sparling and Lewis (1979, 1984a). The *Learningames* curriculum has been used as an extensively researched intervention for very young children—serving as the core intervention in the Abecedarian Project and Project CARE, two longitudinal studies span-

ning birth to adolescence for over 130 control and intervention children. The studies demonstrated significant cognitive and language gains and long-lasting improvement in school achievement for disadvantaged children who participated in this program as a part of their early day care experience (Ramey, Bryant, Campbell, Sparling, & Wasik, 1988; Wasik, Ramey, Bryant, & Sparling, in press).

A recent study by researchers at Johns Hopkins University compared the *Learningames* curriculum and the most commonly used type of physical therapy, neurodevelopmental treatment (NDT) (Stern & Gorga, 1988), as two alternative programs for forty-eight 1-year-olds with spastic diplegia. The study revealed that *Learningames* is more effective than NDT in promoting motor and cognitive gains in these young children with handicaps (Palmer et al., 1988).

The first data showing the efficacy of the second-generation *Partners* curriculum are from the Infant Health and Development Program, a 3-year study in eight cities involving 985 LBW infants, which demonstrated that *Partners* has a positive effect on Age 3 outcomes when implemented for LBW children through day care centers, home visitation, and parent groups. The 36-month IQ advantage for children who received the intervention was 6.6 points for those with birthweight $\leq$ 2,000 grams and 13.2 points for those with birthweight from 2,001 to 2,500 grams (Infant Health and Development Program, 1990). Another analysis of the IHDP data revealed that the child effect was related to the degree of family participation in the intervention program as indexed by the number of days of child attendance in the child development center, the number of home visits completed, and the number of parent group meetings attended (Ramey et al., in press).

New Evidence of Efficacy

In the Infant Health and Development Program, we collected data on the daily implementation of the *Partners* curriculum. These implementation data enabled us to look beyond the established effects with membership in the intervention group (Infant Health and Development Program, 1990) and with degree of family participation (Ramey et al., in press), and to search for effects related specifically to the curriculum itself.

Four variables were chosen to represent curriculum implementation: two quantity variables (Activities Introduced in the CDC, and

Activities Introduced During Home Visits) and two rate variables (Activity Episodes Per CDC Day, and Activities Per Home Visit (see Note 2). The frequency distributions for the quantity variables (see upper panels in Figure 1) show that the modal number of *Partners* curriculum activities introduced was about 170 in the child development center (CDC) and about the same number in the home visits. The range of these two distributions was also similar, but with a few children receiving about 20 more activities in the 3 years of home visiting versus the 2 years of CDC attendance. However, the ranges of the rate variables (see lower panels in Figure 1) were different by design. The home visit protocol set the maximum number of Activities Per Home Visit at three, while no limit was set for the Activity Episodes Per CDC Day. As a result, the modal number of home visit activities was about 2.3 while the modal number of activity episodes per day in the CDC was about 6.5. The range of these two variables is of particular programmatic importance and will be described later.

We began our investigation by asking, through a regression analysis, whether use of the curriculum was associated with an effect that was *in addition to* the effects identified in previously reported analyses. Of the four curriculum implementation variables, the two rate variables were chosen for the regression analysis. The two quantity variables were not used, because one of the previously reported variables, the Participation Index, acted as a limiting factor on the quantity of curriculum received. That is, if a child had low participation, it was impossible for that individual to receive a substantial quantity of the curriculum.

The analysis data set consisted of children who received at least one activity both at the CDC and during a home visit. A total of 314 children from the IHDP project satisfied this criterion and additionally had complete data on the variables included in the regression models. The analysis reported here built upon findings that resulted from earlier work (Infant Health and Development Program, 1990; Ramey et al., in press). The set of seven initial status variables identified in this earlier work as important covariates (Birthweight, Intervention Site, Gender, Maternal Age, Maternal Education, Maternal Race, and Neonatal Health Status) were included in the models presented here in order to control for the effects of the study design and potential confounding. These variables were entered into the models as a block, without testing for individual variable significance levels. The two rate variables were entered into the model after the initial status variables and the participation index. The order of entry of these rate variables was

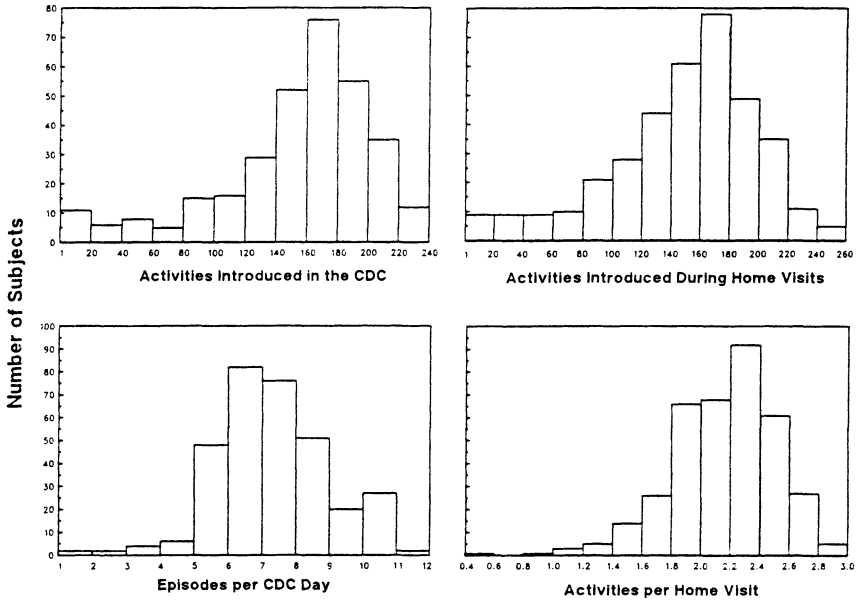

Figure 1. Number of subjects receiving various quantities and rates of curriculum through the CDC and through home visits.

based upon *a priori* considerations of the underlying intervention model in order to avoid multiple testing and to better control our Type I error rate. The three arms of the study, ordered as to hypothesized impact of the intervention, were (1) CDC, (2) home visits, and (3) parent group meetings. The third arm did not contain any child curriculum. Consequently, Activity Episodes Per CDC Day was entered into the model first, followed by Activities Per Home Visit.

Interactions between the curriculum variables and the set of initial status variables were examined for significance in building the final model. Residual analyses were conducted to verify the model assumptions. Previous analyses had found that the participation variables are correlated with one another. Consequently, we chose the order of entry *a priori,* as described above, and report here only sequential test statistics.

The initial status variables and the Participation Index accounted for 39% of the variance (see Note 3) in predicting the 36-month Stanford Binet IQ, and assured that the remaining variables in the model would account for unique variance not associated with the status of

the child and family or the simple fact that they showed up for the program. The entry into the model of Activity Episodes Per CDC Day accounted for an additional 2% of the variance, $F(1,295) = 11.36$, $p < .0008$, and the further addition of Activities Per Home Visit accounted for another 6%, $F(1,295) = 31.74$, $p < .0001$. When interaction effects were checked, it was determined that Activity Episodes Per CDC Day interacted with Birthweight so that lighter LBW children were more affected than heavier LBW children by variation in activity episodes. This interaction accounted for another 2% of the variance, bringing the final multiple R^2 to .49, $F(1,295) = 11.47$, $p < .0008$. Unadjusted R^2 statistics are reported throughout this analysis; the test statistics reported correspond to a test of the hypothesis that a variable is associated with the outcome, conditional on adjustment for all remaining variables being in the model.

In the multiple regression model, the CDC curriculum variable was entered before the home visit curriculum variable, based on our *a priori* hypothesis and our earlier findings that the CDC is a more powerful intervention modality (Wasik et al., in press). It was somewhat surprising then to find that the increase in R^2 associated with Activity Episodes per CDC Day was only .02 as a main effect (plus an additional .02 in an interaction effect), while Activities per Home Visit added .06 points as a main effect. Perhaps the curriculum delivered through home visitation is more powerful in the IHDP intervention than in our earlier research, or the Participation Index masks (or incorporates) more of the effect of the CDC variables as compared to the home visit variables, or the interaction with birthweight partly masks the effect of this particular CDC variable.

In order to further illustrate the relationship between the curriculum variables and IQ, partial regression plots were generated for each of the curriculum rate variables based on the multiple regression models described earlier. Figure 2 contains a plot for Activities Per Home Visit,

Table 2. Multiple Regression Model Including Curriculum Rate Variables to Predict 36-Month Stanford Binet IQ

Variables	Sequential R^2 statistics
Initial Status	.34
Participation Index	.39
Activity Episodes Per CDC Day	.41
Activities Per Home Visit	.47
Birthweight X Activity Episodes Per CDC Day	.49

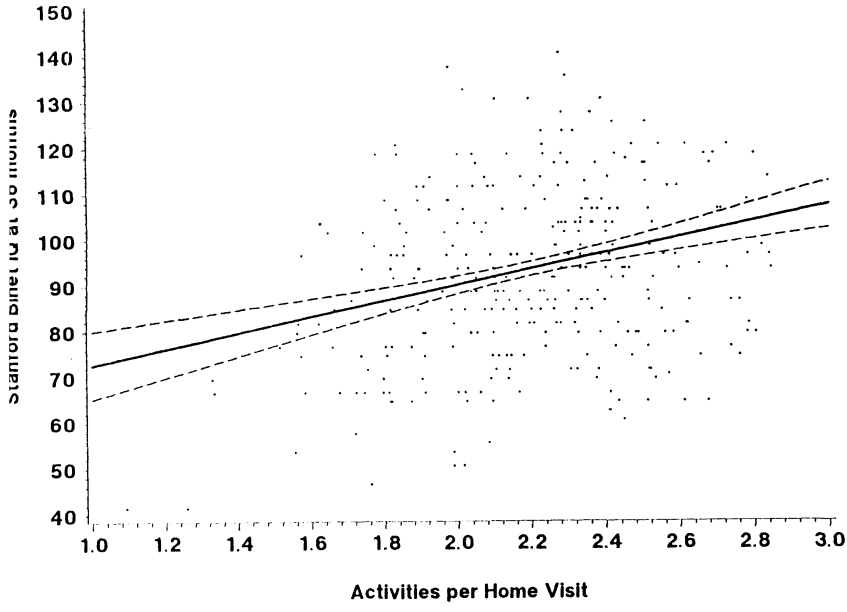

Figure 2. Partial regression plot for IQ as a function of Activities Per Home Visit.

nd Figure 3 contains plots for Activity Episodes Per CDC Day. The catter plots include observed values of IQ and the rate variable of nterest for the analysis subset described earlier ($n = 314$). The predic- ion equation of IQ as a function of the rate variable, fixing all other ariables in the model at their sample average values (see Table 2), s shown on the graph with 95% confidence bands about the line (e.g., Cleinbaum, Kupper, & Muller, 1988). The slope of this prediction quation is equal to the regression coefficient for the rate variable in he multiple regression model. The *additional* information provided y including the curriculum rate variable in the model is illustrated y the significance of the slope of the prediction line. For a given value f Activities Per Home Visit on the x-axis in Figure 2, for example, he expected value of IQ under the model, assuming the sample aver- ge for all other model variables, is given by the y-axis coordinate of he predicted equation graph, and an approximate 95% confidence and for this expected value is given by the vertical distance between he confidence bands (shown as broken lines) at that x-axis coordinate.

In considering the substantial difference in the plots for these two urriculum rate variables, it is useful to recall the range and frequency

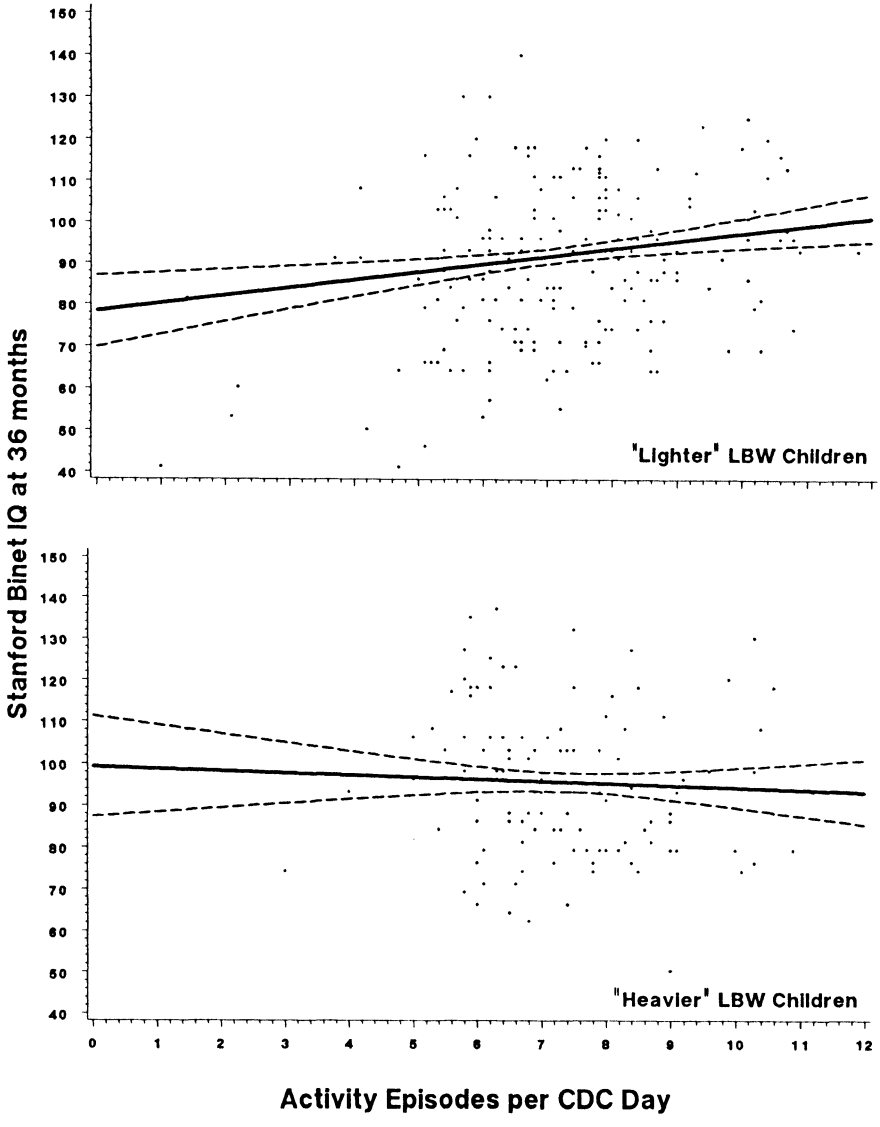

Figure 3. Partial regression plot for IQ as a function of Activity Episodes Per CDC Day for "lighter" children (1,554 g average birthweight) and for "heavier" children (2,249 g average birthweight).

distributions of each (see lower panels in Figure 1). Activities Per Home Visit has a restricted range, 1 to 3, and 80% of the distribution falls between 1.7 and 2.6 activities, a difference of about 1 activity. Rounding these figures off, and speaking in practical terms, the partial regres-

sion model leads us to believe that a child receiving an average of 1½ activities per home visit (and who receives *average* scores on the other variables, including initial status, participation, and Activity Episodes Per CDC Day) would have a predicted 36-month IQ of about 80, whereas a child (with the same average values on the other variables) who was given one more activity per visit (2½ activities) would receive a predicted IQ of almost 100. This appears to be a very large jump in predicted outcome based on the addition of just one more activity per visit, but this addition, in fact, increases the total number of activities administered through the home by 66%. (The limited range of this variable does not invalidate the estimation results presented here but does prevent inference beyond the range studied.)

The example given above probably includes most of the effective variation that would be useful to an intervention program planner. Given these data, one would not wish to use fewer than 1½ curriculum activities per visit. And since 2½ activities predicts a score that is slightly higher than the mean values we have produced in our previous interventions (Ramey et al., 1988), it is our strong assumption that further increases in Activities Per Home Visit would not yield similarly dramatic benefits. Further, it must be remembered that, although these effects are associated with curriculum activities delivered through the home visitation component, in our study home visits were not used separately from parent groups and day care and, therefore, these results cannot be extrapolated to programs of home visitation alone.

The interaction of Birthweight with Activity Episodes Per CDC Day is presented, for clarity, in two partial regression plots. Since the original design of the study stratified the sample into "lighter" LBW children (<2,000 g) and "heavier" LBW children (2,001 to 2,500 g), these groups were separated into two scatter plots, and two lines (one representing predictions for children of the average weight of each of these groups: 1,554 g and 2,249 g, respectively) were entered to illustrate the interaction. The effect of Activity Episodes Per CDC Day on 36-month IQ is highly positive for lighter LBW children, as is shown in the upper panel of Figure 3. A child at the group mean for the lighter group (who has average values on all the other variables, including Activities Per Home Visit) is predicted to have about an 80 IQ if episodes are 1 per day and a 100 IQ if episodes are 12 per day. However, because 80% of the distribution of episodes falls between 5.4 and 9.7 episodes per day, we believe that, for the intervention program planner, 5 activity episodes per CDC day (predicting an IQ of 88) might be considered a basic minimum for these lighter LBW children, with

useful variation up to 10 episodes per day (predicting a 98 IQ). Since CDC teachers were not given any guidance regarding the number of daily activity episodes, 10 can be said to be an empirically derived maximum based on some practical limits of implementation and record keeping in a child development center.

The picture is quite different for children in the heavier LBW group (see the lower panel of Figure 3). A child at the mean weight of this group (with average values on the initial status variables, participation, *and* Activities Per Home Visit) is predicted to receive an IQ in the 90s, regardless of the specific number of episodes received per day. The prediction has the appearance of being better at the lower range of episodes, but the $-.5$ slope of the line is not statistically significant, $t\,(1,295) = -.62$, $p = .54$, and this line should be interpreted as not different from horizontal.

The importance of this interaction effect for the intervention program planner may be profound. For heavier LBW children in a comprehensive program including home visits, the number of CDC activity episodes might be allowed to vary based on individual teacher styles and child preferences. However, for lighter LBW children in the same comprehensive program, the number of episodes is highly salient. Activity Episodes Per CDC Day should not be allowed to drop below 10 per day if the program goal is an IQ of 98 or higher. (The recommendation of course, is not based on a known causal relationship but on a demonstrated association between higher daily rates of curriculum use and higher IQs.)

To complement the regression analyses that featured the curriculum rate variables, we chose a curriculum quantity variable for a final descriptive summary of cognitive performance as a function of curriculum use. We were interested in using a curriculum variable that would provide a view parallel to that of the Participation Index—because we thought the Index not only represented program contact but also (unavoidably) stood for curriculum use that typically accompanied participation. The variable Activities Introduced in the CDC was chosen because it was highly correlated ($r = .83$) with child development center attendance, one of the most important measures included in the Participation Index.

Following the strategy of the earlier participation analysis (Ramey et al., in press), the children were divided into terciles based on their number of Activities Introduced in the CDC, and further subdivided into "lighter" ($<2{,}000$ g) and "heavier" (2,001 to 2,500 g) birthweights. Each group's mean 36-month Stanford Binet IQ is displayed

for comparison in Figure 4. Membership in the middle CDC curriculum activity tercile as compared to membership in the low activity tercile has an advantage of 13 IQ points for the lighter LBW children and of 6 IQ points for the heavier LBW children. However, only two additional IQ points for both weight groups are associated with being in the high CDC activity tercile. (This display of data is descriptive; the values are not corrected for the effects of other variables, nor are tests of significance applied. However, the mean IQs of 82 at the low end and 100 at the high end conform to the range of the predicted values of the regression analyses in which all variables other than the one under consideration were controlled.)

The average number of *Partners* activities received by each of the terciles is, low to high, respectively: 99, 166, and 199. This suggests that there may be a critical range in the lower half of the distribution (that is, between 99 and 166 activities) in which the effect of the curriculum becomes manifest—especially for the lighter LBW children. To be conservative, program planners should use the number 166 as a guide to the quantity of CDC curriculum activities necessary in a 2-year period to produce a mid-90s IQ in a comprehensive program for children of low birthweight.

In the first published IHDP analysis, mean IQ differences favoring the experimental over the control group were twice as large for the heavier LBW children (Infant Health and Development Program, 1990). Thus, it is noteworthy that the largest predicted gains in the regression analysis and the largest mean difference in the descriptive analysis of the present study are for the *lighter* LBW children. Even though the mean for the heavier LBW group received a great boost from the total intervention treatment, the present analyses suggest that the implementation of the curriculum in the child development center is more critical for the lighter LBW group. The lighter children appear to gain more from adequate implementation of the curriculum and to suffer more from below-average curriculum use.

Conclusion

Does greater curriculum use produce higher IQ? We cannot say from this study. However, because a causal link from curriculum to IQ is the implicit assumption of most early intervention programs, and because the field of early intervention operates by manipulating

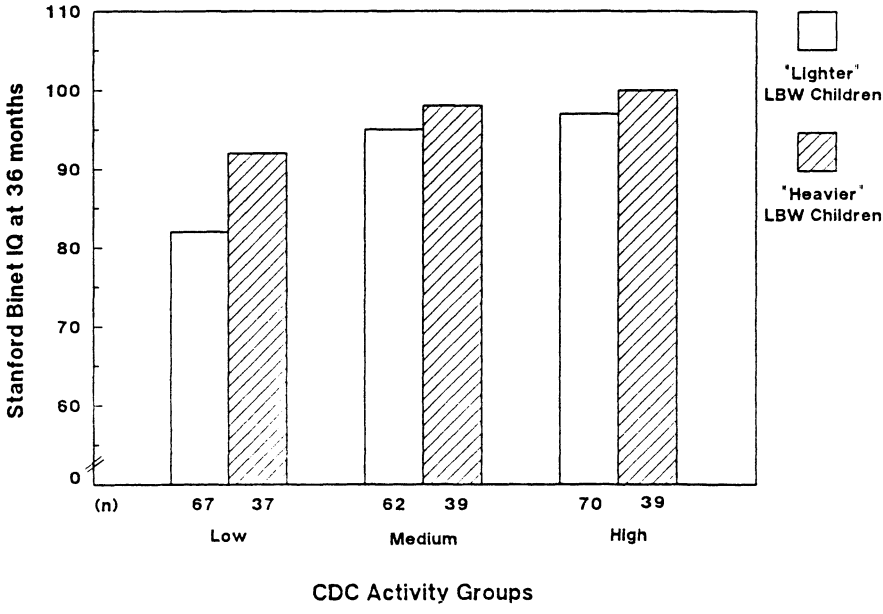

Figure 4. Mean Stanford Binet IQ at age 36 months for children in "lighter" (<2,000 g) and "heavier" (2,001 to 2,500 g) birthweight groups receiving three quantities of curriculum activities in the child development center.

the only variables available for manipulation—curriculum and other program variables—we have included comments and recommendations at several points in the text on amounts and rates of curriculum use, typically favoring higher amounts based on the associations observed. These recommendations do not mean that teachers and parents should hurry children along at any cost, but, rather, that they should be careful not to let the quantity and rate of the program fall below certain reasonable minimums.

If instead of following the creed of the intervener, one were to objectively argue causation, it would be equally logical to suggest that (a) IQ influences curriculum use, (b) curriculum use influences IQ, or (c) both IQ and curriculum use are influenced by one or more other variables. In the present analyses we have tried to move a step beyond this three-point quandary by designing our analyses with IQ as the outcome, but adjusting first for a number of initial status variables (including Maternal Education, Maternal Age, and Birthweight) that are known to predict child IQ. By removing the effect of these and other factors before examining the association of curriculum use and

IQ, we believe we have used a conservative model to study curriculum as a component of intervention. To date, our curriculum research depends on the technique of multiple regression modeling to statistically separate the specific intervention effect of *Early Partners* and *Partners for Learning* from the general effects of participation in home visitation, day care, and parent groups. We hope that future studies will be able to experimentally compare *Partners* to participation without curriculum, to other curricula, or to various levels of curriculum. It will be equally important to determine whether the results of this multiple-modality intervention could be achieved through home visiting alone or day care alone.

Authors' Note

1. We wish to thank Kaye Fendt for data management design and supervision, Vicki Lindsey and Angela Worley for daily data management throughout the IHDP intervention, and Angela Worley for programming assistance.
2. The Infant Health and Development Program was funded by grants to the Department of Pediatrics, Stanford University; the Frank Porter Graham Child Development Center, University of North Carolina at Chapel Hill; and the eight participating Universities by the Robert Wood Johnson Foundation. Additional support for the National Study Office was provided to the Department of Pediatrics, Stanford University, from the Pew Charitable Trusts; the Bureau of Maternal and Child Health and Resources Development, HRSA, PHS, DHHS (Grant MCJ-060515); and the Stanford Center for the Study of Families, Children, and Youth. Additional support to the Frank Porter Graham Child Development Center was provided by the National Institute of Child Health and Human Development and the State of North Carolina.

Notes

1. From this point onward, the terms *premature, low birthweight* (LBW), and *preterm* are used interchangeably to refer to the children of this study.
2. An "activity" is an educational game or interaction described on one of the 326 curriculum cards; an "episode" is an instance in which a curriculum activity is used.
3. Individuals who had a zero or missing value on the home visit curriculum rate variable and/or the CDC curriculum rate variable were excluded from the multiple regression analysis (and are not shown in the frequency distributions) with the rationale that the analysis was concerned with the effect of at least *some* curriculum. This accounts for minor differences in the multiple *Rs* previously reported in our earlier analysis of the Participation Index (Ramey et al., in press), in which zero curriculum values were included.

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