Beginning Reading

If there is one thing Americans can agree on about education, it is that primary schools should teach children to read. Reading is central to a child's experience of school. How well children learn to read becomes the core information that the school and the children themselves use to determine whether or not they are good students.

What has been learned about the teaching of reading underlines almost every point the task force has to make about the first stages of schooling in America and about children's learning. It shows that instruction can outweigh children's supposedly fixed "abilities." It shows the cumulative contribution of research to the understanding of children's learning and the failure to apply the lessons of research to classroom practice. It shows the importance of monitoring children's progress closely and adapting instruction to each child's individual needs. It shows the weakness of the current professional training of teachers. Lastly, it illustrates the ways that ideological stances can sometimes interfere with the school's ability to adopt the most effective practices.

Phonics and Whole-Language Approach. American education has a long history of conflicts over pedagogy. In the case of reading, the current form of the struggle is between the advocates of "phonics" and "whole language" approaches. The former focuses on the alphabetic principle and stresses teaching children the relationships between sounds and letters. The ability to "decode," proponents of the phonics approach say, empowers children to sound out and read any word in their spoken vocabulary. Therefore, training in letter-sound skill should take precedence over having children read short passages or whole stories.

Proponents of whole-language learning, on the other hand, think that reading, like speech, develops naturally and at individually varying rates, and they stress that since the goal is for children to be able to take meaning from text, they should be immersed in a linguistically rich environment. Reading and being read to from meaningful, extended material, and talking and writing about it, helps children see what reading and writing are for and why they would want to engage in them.

Those who advocate whole-language learning do not deny the alphabetic principle, but they emphasize a child's ability to reason and predict on the basis of context. They see phonics as just one of many ways that new words may be recognized and think that explicit phonics training and drill is unmotivating to children.

But now science has had its say. In her masterful summary and synthesis of these decades of work, *Beginning to Read*, Marilyn Jager Adams makes it clear that both sides have grasped part of the truth but that the extremes of each can seriously hinder the early reader's progress.[1]

This research shows that success in learning to read depends on the ability to distinguish, and attend to, the constituent sounds of words; to recognize letters; and to associate letters — and patterns of letters — with the sounds. Good readers, research shows, attend in a rapid, automatic way to almost all of the letters in the words they read; they also have a practiced sense of the likely associations of sounds in a language and of patterns within words and syllables. Their ability to decode

words *rapidly* is a crucial support for understanding the meaning of clauses, sentences, and paragraphs, since it frees their attention from the word-by-word task in order to turn to the larger structures and to hold more of these in their minds.

Individuals differ in "phonemic awareness" — meaning their ability to attend to the component sounds of a language. But this ability is *not* highly correlated with general intelligence, and it can be taught.[2] With explicit instruction directing their attention to letters and sounds, and with practice using appropriately graded and engaging materials, students who seem to be low in reading ability can in time function within the normal range.

It is also true, however, that children come to school with different amounts of exposure and practice in these sound and symbol distinctions and associations. Children vary, too, in the extent to which the sounds and units of their home language or dialect correspond with those of "standard English." Confronted with such variations, schools cannot be sure whether the differences they find are a matter of the child's ability or the result of prior experience or both. All too often, schools respond as though they were dealing with differences in ability, and they quickly begin to sort students into groups where they are challenged differentially, with different results.

The evidence is that this response is very wrong. With explicit instruction, many children can get on track rather quickly, as though their initial difficulty were just a matter of their not having prior exposure to these aspects of language.[3] With appropriate instruction, even children who have more difficulty can be put on the path to effective reading. The percentage of students who seem to have more serious disabilities is rather small: some studies have found it to be as little as 3 percent; it is certainly under 10 percent. Thus, for almost all students, the focus on their ability, rather than on instruction, effort, and the expectation of success, is a mistake.

A Balanced Approach. Many children benefit greatly from explicit instruction on letter-sound correspondences, and it is wise to provide this even for children who seem to be progressing well — at least for the purposes of checking to make sure their underlying skills are strong. Not checking, and withholding direct instruction about, and practice in, these relationships in the mistaken belief that all children will learn them more naturally and developmentally in context, will doom many children to delays.

At the same time, the evidence is that phonics first, or phonics only, can also be deadly to children's learning. English orthography — the ways sounds are represented in spelling — is often irregular. If children are forced first to memorize and practice all the rules and exceptions in a vacuum, they may decide this is a hopeless enterprise. Discouragement is particularly likely among children who have not already had a lot of experience with being read to, who have not yet learned that reading can be enjoyable, and who have not already absorbed the other conventions of reading English — that reading goes from left to right and top to bottom, that those blocks of separate letters on the page are words, and that these marks on the page are supposed to tell a story or give information.

Practice on the "pieces" of reading should, in fact, happen in the context of the whole act of reading. Much of reading should be about things that are interesting and relevant to the child, as the whole-language approach insists. The trick in the early stages, however, is finding reading materials that engage the child while providing practice on the specific skills in some well-thought-out order (no particular order has been shown to be "right," but eventual coverage is important) and at levels of difficulty that allow each child to recognize most of the words even if he or she has to work at some. Drill and practice on worksheets are not all bad, but these need to be subordinated in the children's minds to actual reading.

The answer is a balanced approach.* In fact, most effective teachers, whatever doctrinal label they may wear, have always found ways to incorporate elements from both approaches. The problem is that most teachers need more help and support in working out ways to balance instruction effectively to match the particular needs of each of their students. Surveys indicate that American teachers are usually given too little professional preparation for understanding the structure of language and its relationship to print; therefore, they are not in a position to make the best judgments about a particular child's skills and what he or she may need to work on or experience next to keep on track.[4] The materials available to teachers, moreover, are often not designed to compensate for these gaps in knowledge, or to supplement teachers' skills — by giving them ways of quickly assessing what students know and where they are in their progress, and pointing them to the right reading materials and tools to give the students the experiences that will keep them moving along.

Most of the books and readers available in schools come with only the sketchiest of indications about how challenging they may be to children, and the variety available in the classrooms may not match the variety needed by the children. Some early reading curricula are moving to remedy these limitations. The Open Court reading series[5] and Success for All[6] are two, but their examples need to be more widely adopted. Tests and indices, like the Degrees of Reading Power,[7] enable teachers to get a general sense of the level of difficulty of text a child can cope with and help them match this with reading materials that will be challenging but not discouraging. But these materials do not provide teachers detailed skill information about beginning reading.

Teachers need to learn much more about what to listen for as their students read aloud and what to do about it. The Primary Language Record and its California parallel, the California Language Record,[8] are tools that encourage teachers to keep running records of their observations of children reading (and writing), and they have the added virtue of enlisting the children's own and their par-

*Note: The thirty years of research reviewed by Adams, much of it sponsored in a heroically sustained effort by the National Institute of Child Health and Human Development,[9] has confirmed and deepened Jean Chall's observations in her influential 1967 book, *Learning to Read: The Great Debate*,[10] and made them inescapable. Former California State Superintendent of Public Instruction Bill Honig has recently published an excellent, accessible review of this work with practical recommendations for what a comprehensive, balanced approach to reading instruction should entail, *Teaching Our Children to Read*.[11] Forceful in its evidence and advice, it also represents a brave look at some of the reasons his own state, which has been a leader in its commitment to whole language, has fared rather poorly in recent national comparisons of reading performance.[12]

ents' attention to their progress and reading interests. But these materials could be strengthened by encouraging teachers to focus more on specific aspects of progress in the early stages.

Much more attention needs to be given to the ways that early reading instruction is organized in schools, so that teachers can give individual attention to children and sufficient time to read and practice. Classes of thirty children make achieving this extraordinarily difficult. Smaller reading groups would be better. As it is, most children in a class are left to their own desultory or worksheet-driven devices as the teacher deals with one subgroup at a time. Success for All[13] demonstrates that a school's resources and personnel can be reorganized during extended parts of the day so that much smaller groups can be working intensively, each with its own trained teacher. With closer attention available from the teacher, the children can be grouped by level but assessed frequently and regrouped in response to each child's progress.

Success for All and Reading Recovery[14] also show the power of giving students short-term, intensive individual attention and tutoring, triggered by early identification of those in need of additional help so that they remain in the regular class and catch up with their peers, rather than being shunted off, often permanently, into a special education stream. Various forms of peer tutoring and interaction can also be used to keep children on task and moving ahead when their teachers are engaged with other children.[15]

As rapid decoding is consolidated, children need to be moving on to more and more complicated and richer text. At this point it becomes clear that reading is much more than an independent skill; it is also a reflection of everything that a child already knows and of all of the things he or she wants to know or do next. It is clearly true that the essential way of improving reading is to read — for pleasure and for information — as much as possible, though it is helpful if the teacher can ensure that much of that reading is, again, at a level that challenges but does not discourage.

The most effective readers come out of experiences in which they not only read but are given specific support in thinking about how they read and how language and syntax are structured — about how they know what they think they know from what they have read. Children need to read a lot, but they also need to be encouraged to reflect on what they read, and sometimes it helps to put labels on the strategies and tactics they use, *after* they have actual experience in using them, so that they can be encouraged to exercise these more.[16]

Responsibility of Parents, Schools, and Community. These pages have been about learning to read in the context of schools. It is clear that children vary in their familiarity with reading and its components mainly because of the variability in their experience before and outside of school. It is the school's responsibility to understand these sources of variability and to adapt instruction to them to bring each child up to a high level of effectiveness in reading. But the school's job will be easier, and the children's chances better, if parents, preschool educators, and staffs of after-school programs also immerse children in a linguistically rich environment, where reading is central and commonplace and where those who care about the children show them what reading is about and how it can open the door to new worlds of understanding and fun.

APPENDIX B

Reading Skills Curriculum Timeline—Preschool Through Fifth Grade

The timeline in Table B-1 describes the specific skill development components of a reading program and when they should be taught. Each cell on the chart represents an essential component of literacy instruction. Instructional activities/***benchmarks*** in each cell are representative of that component; they are not intended as a comprehensive list. (Benchmarks are printed in italics.)

Each area of the curriculum is reciprocally related (some more strongly than others)—for example, learning phonemic awareness helps learn letter/sound correspondence and vice versa. Children should be diagnosed regularly and intensified instruction or tutoring offered for those who fall behind. *All curricular areas up to January of first grade are aimed at enabling children in independently read beginning material.* This and other milestones in this chart are targets which *most* children should meet; of course, some will become independent readers earlier and some will take longer. Once independent reading is achieved, the goal is to keep students reading grade-appropriate text.

Table B-1

	Preschool	Kindergarten	First Grade: Fall*	First Grade: January to June*	Second Through Fifth
Listening and Discussion**	Listening to stories Discussing stories	Listening to stories Discussing stories	Listening to stories Discussing stories	Listening to stories Discussing stories	Listening to stories Discussing stories
Oral Discussion	Story telling Story re-telling Saying nursery rhymes	*Story telling* *Story re-telling* *Saying nursery rhymes*	Story telling Story re-telling Explanations	Story telling Explanations Beginning group discussions	Reports to class Group discussions —taking turns, responding Plays, recitations
Phonemic Awareness	Recognizing rhymes Hearing separate words Rhyming words	*Hearing syllables* *Rhyming words* *Oral comparisons* *Identification and blending of sounds* *Identifying syllables and word families* *Counting or matching the sounds of words*	*Segment initial, final, medial phonemes* *Blending phonemes* *Transpose* cat to fat *Deletion tasks*	*More complex segmentation, blending, and transpositions*	
Print Awareness	Pretend reading Recognizing signs	*Basic elements such as word boundaries, left to right sweeps*	*Full print awareness*		

(continued)

Table B-1 (Continued)

	Preschool	Kindergarten	First Grade: Fall*	First Grade: January to June*	Second through Fifth
Syntactic Awareness		*Understands how sentences and phrases work* *Understands word order* Shared reading	Anticipation of words Sentence structures Clues from mechanics —caps, periods, and commas	Beginning grammar Paragraphs	Text structure, e.g., story structure, poems, book reviews, newspaper articles, editorials More complex grammar
Letter Recognition	Exposure to letter names *Recognition of name*	*Knows most letter names* *Recognizes most letter shapes (upper and lower case)*	*Knows all letter names and shapes*		
Sound/Symbol Correspondence		*Knows some letter sounds*	*Knows basic letter and letter pattern/ sound correspondence*	*Complex letter/sound correspondences*	Remaining correspondences
Recognizing Word Families (words that sound alike and have similar letter patterns)		Attention to on-set and rimes, e.g., *r* and *ing* and *s* and *ing*	Recognizing basic word families patterns (37 rimes such as *in, or,* and *ill* make up 500 primary grade words)	Recognizing most of remaining 272 primary word families, e.g., ine and *ight,* which are regular	
Decoding/Word Attack			*Knows word-attack strategies: sounding out, comparing to similar words, breaking words into smaller words, looking for word parts, e.g.,* ing *and* ed, *generating alternative pronunciations, using phonic, semantic, and syntactic clues, self-correction and self-monitoring* *Guided reading*	Continued development of decoding ability, including use of more complex letter/sound correspondences, simple syllabication	Continued development of decoding ability, including use of complex letter/ sound correspondences and word root/prefixes and suffixes
Recognizing High Frequency Words (irregular and regular)		*Knows some sight words*	*Automatically recognized 50 high-frequency words*	*Recognizes 150 high-frequency words*	

(continued)

Table B-1 (Continued)

	Preschool	Kindergarten	First Grade: Fall*	First Grade: January to June*	Second Through Fifth
Writing/Encoding	Pretend writing Making signs	*Writes words (temporary spelling)* *Writes name* Beginning story writing Group dictated stories	Beginning stages of writing stories, descriptions, persuasions, and reports. Beginning mechanics, e.g., punctuation and capitalization Beginning grammar and usage	Later stages of writing narratives, ex-expository text such as organizing information for a report, arguing a point, etc. Continued mechanics, e.g., capitalization and punctuation More advanced grammar and usage	Writes competently: narratives, reports, advocacy, descriptions Can use mechanics: composition, e.g., sentence structure and paragraph structure; more adanced grammar and usage
Vocabulary—Meaning, Word Parts, Word Play	Word meanings from oral discussions and explanations	Word meanings from oral discussions and explanations *Builds simple words with magnetic letters*	Word meanings from oral discussions and explanations *Learns some new words from reading* *Can use word derivations e.g., adding* ed, ing, *etc.* *Constructs words from given consonants and vowels, and patterns*	Word meanings from oral discussions and explanations Some new words from reading Word structure *Syllabication of simple words* More complex word construction	Word meanings from oral discussions and explanations Most new words from reading—learning from context *Syllabication of more complex words* *Knows system of word roots, suffixes, and prefixes* Synonyms—best and creative word use Semantic trees
Spelling	Making signs	Temporary spelling	Temporary spelling Spells words in reading lessons	*Spells words in reading lessons* *Spells sound families and high-frequency words* *Spells individualized problem words* Corrects temporary spellings in final drafts	Individualized program based on words missed in writing, spelling demons, and spelling lists organized by sound theme Test-study-test Immediate self-correction of tests Proofreading Memory strategies
Independent Reading/ Assigned/Reading/ Guided Reading	Reading good stories and nursery rhymes to children	Reading good stories and informational text to children	Reading for meaning of specifically designed books or appropriate material connected to lessons with teacher or partner Individual or group reading of simple text Reading good stories and informational text to children	Reading narrative and information text becomes the primary learning strategy *Reads and understands 100–200 "little books"* Teacher conferencing Students read and discuss stories, magazines, and informational text from anthologies, reading series, etc. Guided reading Teacher reads to children	*Reads and understands 25–35 grade-appropriate books each year from accepted fiction and nonfiction lists* Reads in depth Teacher conferencing Can engage in in-depth discussions Introduction to a variety of genres Reading in subject matter areas Guided reading Teacher reads to children

(continued)

Table B-1 (Continued)

	Preschool	Kindergarten	First Grade: Fall*	First Grade: January to June*	Second through Fifth
Specific Comprehension Strategies	Picture reading for meaning	Picture reading for meaning	Read for meaning	Read for meaning Discuss books *Can use beginning comprehension strategies—predicting, connecting to what is known, summarizing, etc.*	Discussions strategies, e.g., book clubs *Can use advanced strategic reading skills—predicting, summarizing, connecting, and visualizing*
Fluency			Re-reading of familiar material Oral reading	Re-reading of familiar material Expression Phrasing Oral reading	Continued work on expression, phrasing and oral reading *Can read orally—accurately, fluently and with expression*

NOTES: *For year-round or alternative year schedules, *Fall* means the first 4 months of first grade or equivalent, and *January to June* means the last 5½ months or equivalent.

**Italaics indicate benchmarks for each grade level.

PHONOLOGICAL AWARENESS

- ANALYZING AND COMBINING THE SMALLEST UNITS OF DISCERNABLE SOUND (PHONEMES) IN VARIETIES OF WAYS, IN ORDER TO CONNECT THE SYMBOLS (LETTERS) WHICH REPRESENT THEM, TO SPECIFIC MEANINGS

EXAMPLES OF PHONOLOGICAL AWARENESS TASKS

- PHONEME DELETION: WHAT WORD WOULD BE LEFT IF THE /k/ SOUND WERE TAKEN AWAY FROM CAT?
- WORD TO WORD MATCHING: DO PEN AND PIPE BEGIN WITH THE SAME SOUND?
- BLENDING: WHAT WORD WOULD WE HAVE IF YOU PUT THESE SOUNDS TOGETHER: /S/,/A/,/T/?
- PHONEME SEGMENTATION: WHAT SOUNDS DO YOU HEAR IN THE WORD HOT?
- PHONEME COUNTING: HOW MANY SOUNDS DO YOU HEAR IN THE WORD CAKE?
- RHYMING: TELL ME AS MANY WORDS THAT YOU KNOW THAT RHYME WITH THE WORD CAT?

CLASSIFICATION/DEFINITION

- THE DEFINITOIN AND CLASSIFICATION OF LEARNING DISABILITIES AND DYSLEXIA MUST BE ACCOMPLISHED WITHIN A LONGITUDINAL DEVELOPMENTAL FRAMEWORK THAT DOES NOT REQUIRE ADHERENCE TO A PRIORI ASSUMPTIONS REFLECTED IN CURRENT DEFINITIONS. FUTHER, A VALID DEFINITION CAN BEST BE DEVELOPED BY STUDIES THAT INVESTIGATE REPRESENTATIVE GROUPS OF CHILDREN OVER TIME AND THAT DOCUMENT HOW DIFFERENCES AMONG CHILDREN EMERGE, CHANGE, AND INFLUENCE FUTHER DEVELOPMENT

CLASSIFICATION/DEFINITION CONTINUED [1]

- CURRENT EXCLUSIONARY DEFINITIONS OF LEARNING DISABILITIES APPEAR TO BE INVALID, PARTICULARLY IN THE AREA OF READING DISABILITIES AND PARTICULARLY WHEN DISCREPANCY FORMULAE ARE USED

READING AND LANGUAGE RELATED PROCESSES

- READING DISABILITIES (DYSLEXIA) AFFECT AT LEAST 10 MILLION CHILDREN, OR APPROXIMATELY 1 CHILD IN 5

- WHILE SCHOOLS IDENTIFY APPROXIMATELY FOUR TIMES AS MANY BOYS AS GIRLS AS READING DISABLED, LONGITUDINAL AND EPIDEMIOLOGICAL STUDIES SHOW THAT AS MANY GIRLS ARE AFFECTED AS BOYS

READING AND LANGUAGE RELATED PROCESSES CONTINUED

- READING DISABILITY REFLECTS A PERSISTENT DEFICIT RATHER THAN A DEVELOPMENTAL LAG IN LINGUISTIC AND READING SKILLS. LONGITUDINAL STUDIES SHOW THAT OF THE CHILDREN WHO ARE READING DISABLED IN THE THIRD GRADE, 74% REMAIN DISABLED IN THE NINTH GRADE

READING AND LANGUAGE RELATED PROCESSES CONTINUED

- THE PRACTICE OF DISTINGUISHING BETWEEN DISABLED READERS WITH AN IQ-ACHIEVEMENT DISCREPANCY AND THOSE WITHOUT A DISCREPANCY APPEARS INVALID. MORE SPECIFICALLY, CHILDREN WITH AND WITHOUT A DISCREPANCY DO NOT DIFFER IN THE INFORMATION PROCESSING SUBSKILLS (PHONOLOGICAL AND ORTHOGRAPHIC CODING) THAT ARE NECESSARY FOR THE READING OF SINGLE WORDS. LIKEWISE GENETIC AND NEUROPHYSIOLOGICAL STUDIES HAVE NOT INDICATED DIFFERENTIAL ETIOLOGIES FOR READING DISABLED CHILDREN WITH AND WITHOUT DISCREPANCIES. IT REMAINS TO BE SEEN WHETHER A DISCREPANCY BETWEEN ACHIEVEMENT AND IQ IS A WORTHWHILE PREDICTOR OF RESPONSE TO INTERVENTION

READING AND LANGUAGE RELATED PROCESSES CONTINUED[3]

- CHILDREN WITH READING DISABILITY DIFFER FROM ONE ANOTHER AND FROM OTHER READERS ALONG A CONTINUOUS DISTRIBUTION, AND DO NOT AGGREGATE TOGETHER IN A DISTINCT "HUMP" AT THE TAIL OF THE DISTRIBUTION AS ONCE THOUGHT

READING AND LANGUAGE RELATED PROCESSES CONTINUED[5]

- THE ABILITY TO DECODE SINGLE WORDS ACCURATELY AND FLUENTLY IS DEPENDENT UPON THE ABILITY TO SEGMENT WORDS AND SYLLABLES INTO ABSTRACT CONSTITUENT SOUND UNITS (PHONEMES). DEFICITS IN PHONOLOGICAL AWARENESS REFLECT THE CORE DEFICIT IN DYSLEXIA

READING AND LANGUAGE RELATED PROCESSES CONTINUED

- THE BEST PREDICTOR OF READING ABILITY/DISABILITY FROM KINDERGARTEN AND FIRST GRADE TEST PERFORMANCE IS PHONEME SEGMENTATION ABILITY. HOWEVER THERE MAY BE DIFFERENT PREDICTORS FOR DIFFERENT COMPONENT READOMG SKILLS. FOR EXAMPLE, RAPID NAMING ABILITY MAY PREDICT WORD IDENTIFICATION WHILE TASKS ASSESSING PHONOLOGICAL AWARENESS BEST PREDICTS WORD ATTACK SKILLS

ATTENTION

- A PRECISE CLASSIFICATION OF ADD WITH AND WITHOUT HYPERACTIVITY IS NOT YET AVAILABLE. A CLASSIFICATION METHODOLOGY THAT ASSESSES INTERNAL AND EXTERNAL VALIDITY OF DIMENSIONAL AND CATEGORICAL MODELS MUST BE APPLIED TO THE ISSUE

- ADD AND READING DISABILITY OFTEN CO-EXIST, BUT THE TWO DISORDERS ARE DISTINCT AND SEPARABLE

ATTENTION CONTINUED [1]

- ADD OCCURS MORE FREQUENTLY IN MALES AND ADD EXACERBATES THE SEVERITY AND COGNITIVE MORBIDITY OF READING DEFICITS. SINCE ADD AND READING DEFICITS OFTEN CO-OCCUR, MORE MALES ARE TYPICALLY IDENTIFIED AS READING DISABLED, SPURIOUSLY INFLATING THE GENDER RATIO IN FAVOR OF MALES

NEUROANATOMY, NEUROPHYSIOLOGY, AND NEUROIMAGING

- THERE IS CONVERGING EVIDENCE FROM ANATOMICAL MICROSTRUCTURE STUDIES, GROSS MORPHOLOGY STUDIES, AND NEUROIMAGING STUDIES THAT THE PHENOTYPIC EXPRESSION IN DYSLEXIA IS RELATED TO ANOMALOUS ORGANIZATION OF TISSUE AND PROCESSING SYSTEMS SUBSERVED WITHIN THE POSTERIOR LEFT HEMISPHERE

TREATMENT/INTERVENTION

- DISABLED READERS DO NOT READILY ACQUIRE THE ALPHABETIC CODE WHEN LEARNING TO READ DUE TO DEFICIENCIES IN THE PROCESSING OF PHONOLOGICAL INFORMATION. AS SUCH, DISABLED READERS MUST BE PRESENTED HIGHLY STRUCTURED, EXPLICIT AND INTENSIVE INSTRUCTION IN PHONICS RULES AND THE APPLICATION OF THE RULES TO PRINT

TREATMENT/INTERVENTION CONTINUED [1]

- LONGITUDINAL DATA INDICATE THAT SYSTEMATIC STRUCTURED PHONICS INSTRUCTION RESULTS IN MORE FAVORABLE OUTCOMES IN READING THAN DOES A CONTEXT-EMPHASIS (WHOLE LANGUAGE) APPROACH

GETTING READY TO READ

Learning How Print Maps to Speech

by Benita A. Blachman

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GETTING READY TO READ

Learning How Print Maps to Speech

Benita A. Blachman

"The Reading Wars" was the title of a recent article in a special edition of *Newsweek* magazine (Kantrowitz 1990). Regrettably, it is an apt title to describe the dissension in the reading community over how reading is to be taught to young children. If we agree that "the ability to read well is basic to our national survival" (Chall 1989, p. 521), then perhaps the passion that fuels the reading controversy will be easier to understand. Unfortunately, the losers in this "reading war" are too often the children who are not getting the best that we have to offer. As educators and researchers debate the value of phonic versus meaning-based approaches to reading (the most popular, at the moment, being whole language) or, as they are more generically referred to, skills-based approaches versus literature-based approaches, a significant number of children continue to fail to learn to read. Even as adults, it is estimated that 20% of the population continue to have severe problems with the most common reading activities (Stedman and Kaestle 1987).

AN EMPHASIS ON LANGUAGE

Instead of focusing on theoretical divisions in the field, it might be more constructive to ask if there is anything related to reading about

which we all agree. It is safe to say that there is now a consensus that reading is a language-based activity. Although today we tend to take this simple observation for granted, in the '60s and well into the '70s a different point of view prevailed. The alternative viewpoint was perhaps best summarized by George Spache (1961), a noted authority in the reading field, who wrote: "It seems fairly obvious that reading, like most school work, is primarily a visual act" (p. 3). As a consequence of the emphasis on vision, the focus at that time in explaining reading problems was on identifying and remediating deficits in visual perception. Eventually the visual perceptual deficit explanation of reading difficulties was questioned, and numerous researchers presented evidence that directly contradicted it (Benton 1975; Larsen and Hammill 1975; Vellutino 1977, 1979). In the last two decades, we have seen a renewed interest in a language-based view of reading and its disabilities (Kamhi and Catts 1989; Kavanagh and Mattingly 1972; Liberman 1971, 1983; Shankweiler and Liberman 1989; Vellutino 1979, 1987). In the context of that perspective, we have made great strides in our understanding of literacy acquisition.

As a consequence of the emphasis on language that pervades the reading community, a number of promising practices are appearing in preschool, kindergarten, and first grade classrooms that emphasize the creation of a rich environment of oral and written language (Anderson et al. 1985; Durkin 1989). In *Becoming A Nation of Readers: The Report of the Commission on Reading* (Anderson et al. 1985), written under the auspices of the National Academy of Education and sponsored by the National Institute of Education, the Commission reports that:

> Reading must be seen as part of a child's general language development and not as a discrete skill isolated from listening, speaking, and writing. Reading instruction builds especially on oral language. If this foundation is weak, progress in reading will be slow and uncertain (p. 30).

The Commission, charged with the task of synthesizing the best research in reading and translating that research into guidelines for practice, proceeded to describe the elements needed to foster the emerging literacy of the preschool and kindergarten child. The essential elements included, for example, extended conversations at home with parents and experiences with written language. Specific emphasis was placed on conversations that require reflection and that will help children "exercise their memories . . . and . . . learn to give complete descriptions and tell complete stories" (p. 23). At the same time, it was suggested that experiences with written language, especially reading aloud to children, should be a priority. To stress its importance, reading aloud to children was described as "the single most important activity for building the knowledge required for eventual success in reading" (p. 23).

The Commission advised continued opportunities in kindergarten to stimulate oral language development and listening comprehension through thoughtful discussions—for example, discussions about the storybooks that have been read to the children. The Commission also pointed out that this emphasis on oral language development, although necessary, is not sufficient to guarantee success in reading. Children need to acquire knowledge about written language related to both form (e.g., we hold the book right side up and turn the pages from front to back) and function (e.g., it can entertain, instruct, or direct). They also need to acquire knowledge of letter names and knowledge about the relationships betweens letters and sounds. Learning to write (whether it is with paper and pencil, with plastic letters, or in front of a computer screen) and encouraging writing, for example, through accepting and encouraging invented spellings (e.g., such as *t* for tame, followed by *tm*, *tam*, and eventually *tame*), is a way to facilitate the acquisition of letter-sound correspondences. It is also a way to encourage a child to use his or her knowledge of written language to communicate with others (Anderson et al. 1985, p. 34).

Although I have taken some liberties in my summary of the Commission's recommendations for preschool and kindergarten children (most notably in deleting some ideas and emphasizing others), it is hard to see how educators from either the phonics/skills-based orientation or the meaning/literature-based orientation to beginning reading could disagree with the recommendations made by this panel. Indeed, if these recommendations were actually in place in all of our preschool and kindergarten classrooms (along with recommendations for later years, such as the suggestion that children should spend more time in independent reading and writing and less time on workbooks), we would be much further along toward our goal of "becoming a nation of readers."

DIFFERENCES IN PRESCHOOL LITERACY EXPERIENCES

It is important to remember, of course, that children come to school with differing levels of awareness about the conventions of written language and about the connections between oral and written language. A vivid description of these differences and their influence on literacy acquisition is described by Adams (1990) in her book *Beginning to Read: Thinking and Learning about Print*. For example, Adams describes her

own child's experiences with print, especially having been read to on a regular basis, and calculates that somewhere between 1,000 and 1,700 hours will have been spent reading to John "one-on-one, with his face in the books" (p. 85) before he enters first grade. Others also have found that this frequency of reading to children is commonplace in culturally mainstream homes (Heath 1983). In addition, Adams also estimates that her son spent 1,000 hours watching "Sesame Street," and another 1,000 hours in written language activities, such as playing with magnetic letters on the refrigerator, playing word games in the car and on the computer, and participating in oral and written language activities at preschool. As Adams so aptly puts it, "Any way we work it, it seems a safe bet that John and the majority of his culturally mainstream peers will have experienced thousands of hours' worth of prereading activities before entering first grade" (p. 86).

In striking contrast, according to Adams (see also, Feitelson and Goldstein 1986, Heath 1983, Teale 1986, cited in Adams 1990), are the children who have never, or only rarely, been read to, who are living in homes without books, without models of adults who value reading and who read for their own pleasure, without magnetic letters, paper, pencils, crayons, and certainly without a home computer with letter and word games. In addition, there are the children who, despite exposure to a rich oral and written language environment as preschoolers, fail to make the necessary connections between print and speech that facilitate literacy acquisition.

Ideally, these differences in preschool literacy experiences and in learning needs will be taken into account by knowledgeable kindergarten and first grade teachers, who will modify their instruction to accommodate a wide range of individual differences. But, as we know, this ideal is not always reached. If nothing else, these vast differences in preschool experience and in the ability to take advantange of appropriate literacy experiences when they are available, suggest that any single approach, regardless of its orientation, will not meet the needs of all children. For children who haven't learned to recognize the words on the page, an approach that relies only on continued exposure to literature (however "good" the literature) will leave them without the direct instruction they need to make the connections between print and speech. On the other hand, a model that relies too heavily on direct instruction in isolated skills (skills that many children will already have acquired) will leave children without the enrichment and opportunites for rewarding literacy experiences that all children need and deserve.

LEARNING HOW PRINT MAPS TO SPEECH

If, as I suspect, most would accept the recommendations selected from *Becoming A Nation of Readers*, then where, you may wonder, does the great controversy over the teaching of beginning reading lie? One important point of disagreement concerns the way in which children come to understand how print maps to speech. Specifically, we now know that one of the fundamental tasks facing the beginning reader is to develop the realization that speech can be segmented and that these segmented units can be represented by printed forms (Liberman 1971). Although it is obvious to literate adults that the letters of the alphabet more or less represent phonological segments of speech, this awareness cannot be taken for granted in the young child. To appreciate the complexity of the task facing the beginning reader, one must first appreciate the complex relationship among the phonemes in the speech stream. Speech, unlike writing, "does not consist of separate phonemes" produced one after the other "in a row over time" (Gleitman and Rozin 1973, p. 460). Instead, as Liberman and Shankweiler (1991) explain, "in producing the syllable 'ba,' for example, the speaker assigned the consonant we know as 'B' to the lips, and the vowel we know as 'A' to a shaping of the tongue, and then produced the two elements at pretty much the same time" (p. 5). This merging or coarticulation of the phonological segments during speech production (the folding of the consonants into the vowels) (Liberman et al. 1967; Liberman 1971) has advantages for speech but, as we shall see, obscures the segmental nature of the speech stream and makes it difficult for the young child to access the phonological units that are represented by an alphabet. Liberman and Shankweiler (1991) help us understand this phenomenon:

> The advantageous result of such coarticulation of speech sounds is that speech can proceed at a satisfactory pace—at a pace indeed at which it can be understood (Liberman, Cooper, Shankweiler, and Studdert-Kennedy 1967). Can you imagine trying to understand speech if it were spelled out to you letter by painful letter? So coarticulation is certainly advantageous for the perception of speech. But a further result of coarticulation, and a much less advantageous one for the would-be reader, is that there is, inevitably, no neat correspondence between the underlying phonological structure and the sound that comes to the ears. Thus, though the word "bag," for example, has three phonological units, and correspondingly, three letters in print, it has only one pulse of sound: The three elements of the underlying phonological structure—the three phonemes—have been thoroughly overlapped and merged into that one sound—"bag". . . .

> [Beginning readers] can understand, and properly take advantage of, the fact that the printed word *bag* has three letters, only if they are aware that the spoken word "*bag*," with which they are already quite familiar, is divisible into three segments. They will probably not know that spontaneously, because, as we have said, there is only one segment of sound, not three, and because the processes of speech perception that recover the phonological structure are automatic and quite unconscious (pp. 5–6).

As we now know from extensive research conducted during the last fifteen years, developing an awareness of the phonological segments in words is an important prerequisite to understanding how an alphabetic transcription represents speech. "That transcription will make sense to beginning readers only if they understand that the transcription has the same number and sequence of units as the spoken word" (Liberman and Shankweiler 1991, p. 6). An important insight in early reading acquisition is the recognition that, for some children, difficulty in learning to decode occurs precisely because they lack an awareness of the segmental nature of speech and, thus, never fully understand how an alphabet works (Freebody and Byrne 1988; Juel 1988; Stanovich 1986; Williams 1987). The research clearly indicates that children who can demonstrate their phonological awareness by, for example, categorizing words according to common initial, middle, or final sounds, or by counting, deleting, or reversing phonemes, are more likely to be among our better readers. Children who lack this awareness are likely to be among our poorest readers (Blachman 1984; Blachman and James 1986; Bradley and Bryant 1983; Juel 1988; Juel, Griffith, and Gough 1986; Lundberg, Olofsson, and Wall 1980; Mann 1984; Mann and Liberman 1984; Share et al. 1984; Stanovich, Cunningham, and Cramer 1984; Torneus 1984; Vellutino and Scanlon 1987).

In addition to the evidence that phonological awareness is a highly significant and consistent predictor of early reading achievement, there is now evidence from large-scale training studies here and abroad that phonological awareness can be heightened in kindergarten and first grade children (as well as older learning disabled children) through direct instructional activities (Ball and Blachman 1991; Blachman et al. 1991; Bradley and Bryant 1983; Cunningham 1990; Fox and Routh 1984; Lundberg, Frost, and Peterson 1988; Treiman and Baron 1983; Williams 1980). This instruction (taking a variety of forms, as we shall see in this chapter) has been shown to have a positive effect on the acquisition of both reading and spelling. It appears that once children are taught to recognize that speech can be segmented and that these segmented units are represented by letters, the systematic relationships between letters and sounds are easier to grasp and utilize in both reading and writing. To take full advantage of an alphabetic writing system, one must first understand the alphabetic principle. This necessitates learning about the segmental nature of speech and its relationship to print.

In contrast to this view regarding beginning reading, there are those who argue that the use of written language does not require a "high level of conscious awareness of the units . . ." (Goodman and Goodman 1979, p. 139). They suggest as a corollary—and, I might add, without any research to support their premise—that activities that require "breaking whole (natural) language into bite-size, abstract little pieces . . . words, syllables, and isolated sounds" (Goodman 1986, p. 7) make learning to read more difficult. The Goodmans believe that learning to read is as natural as learning to speak (Goodman 1986; Goodman and Goodman 1979). Indeed, it would be convenient if reading and writing were "biologically primary" (Liberman and Liberman 1990) in the same way that speech is biologically primary. Then, reading and writing, like speech, might require only exposure to language to trigger the underlying biological mechanism and get it started. Unfortunately, this is not the case. As noted recently, "although it is popular for authors to cite examples of children who have acquired reading on their own, . . . for the vast majority of children the initial stages of reading must be traversed with the aid of some type of guided instruction from a teacher" (Stanovich 1986, p. 396). We are beginning to realize that, for many children, direct instruction is required to help them understand how print maps to speech.

Teaching Phonological Awareness

Numerous researchers have suggested that phonological awareness activities should be incorporated into the kindergarten and first grade classroom, before children have had a chance to fail in reading and spelling (Adams 1990; Blachman 1989; Juel 1988). There is now a considerable body of research to provide direction for the practitioner who wants to heighten the phonological awareness of children before and during early reading instruction (see Blachman in press for a detailed description of these activities). Although there is no cookbook for the practitioner to follow, the following review of some of the large-scale phoneme awareness training studies reveals an array of activities that can be used by the classroom teacher or clinician. One of the important ways in which these studies differ is whether or not the phonological awareness instruction is combined with instruction linking the phonological segments to the letters of the alphabet. In the first two studies (Cunningham 1990; Lundberg, Frost, and Peterson 1988), activities to

enhance phonological awareness are provided without making the connection to letters. In the next group of studies (Bradley and Bryant 1983, 1985; Ball and Blachman 1988, 1991; Blachman et al. 1991), the connections between the phonological segments in words and the alphabet letters that represent those segments are made explicit during training.

Phonological Awareness Instruction Without Making Explicit the Connections Between Sound Segments and Letters. In one of the largest studies to date, Lundberg, Frost, and Peterson (1988) provided eight months of metalinguistic training to 235 nonreading children in kindergarten classrooms in Denmark. Even though these children were a year older than their counterparts in kindergarten classrooms in the United States, they were not likely to have had much in the way of "informal literacy socialization" (p. 266). By electing to provide a program of instruction that did not include making connections between the sound segments in words and the letters that represent those segments, Lundberg and his colleagues were able to evaluate the impact of training in phoneme awareness, uncontaminated by letter/sound knowledge and prior to formal reading instruction.

In each classroom, the entire group of 15 to 20 children participated in a program that began with listening games, and was followed by rhyming games and segmentation of sentences into words. During the second month of the intervention, children learned to segment multisyllabic words into syllables through a variety of clapping and rhythmic activities. In the third month, phonemes were introduced. Children were first taught to identify initial phonemes, and in the fifth month they learned to segment two-phoneme words and then moved on to more complex items. The program emphasized games, but the authors stress that careful attention was paid to the sequencing, duration, and frequency of the activities. In a previous study, Olofsson and Lundberg (1983) had found that when the structure was varied across treatment conditions, only the most structured group showed improvement from pretest to posttest. The most structured group had participated in lessons three to four times per week for 15 to 30 minutes per lesson, while in the least structured group the teachers introduced the phoneme awareness activities more spontaneously during the normal play activities of the day.

In the more recent Lundberg study (Lundberg et al. 1988), the children who participated in the metalinguistic training demonstrated significantly greater metaphonological awareness than the control children. Although there were no differences between the two groups on measures of prereading after the kindergarten intervention, when the children were tested a year later at the end of first grade, the treatment children significantly outperformed the control children in spelling. At the end of second grade, the treatment children outperformed the control children in both reading and spelling. Thus, Lundberg and his colleagues were able to demonstrate that phonological awareness can be heightened in children who have not yet learned to read, and when formal literacy instruction begins in first grade, this heightened awareness appears to have a facilitating effect on the acquisition of reading and spelling skills.

In a more recent study, Cunningham (1990) also investigated the impact of a phoneme awareness training program that did not include instruction in the connections between sound segments and letters. (It should be noted, however, that although the connections between letters and sounds were not introduced during the treatment activities, the first grade children in this study were involved in formal reading instruction in their classrooms during this 10-week period. We are not told whether letter name and letter sound instruction was taking place in the kindergarten classrooms during this 10-week period.) Kindergarten and first grade children participated in 10 weeks of instruction, meeting twice a week, in groups of four or five for 15 to 20 minute lessons. In a program adapted from *The ABD's of Reading* (Williams 1979), children learned to represent the sounds in words by moving wooden chips. Both segmenting and blending activities were included in the program. At the end of the intervention, the trained kindergarten and first grade children significantly outperformed the control children on measures of phoneme awareness and on a general measure of reading ability.

These studies clearly demonstrate the facilitating effect on beginning reading development of training in phonological awareness, even when the connections between the sound segments and letters are not made explicit during the intervention. By not including instruction in the connections between sounds and letters, these researchers were able to isolate and evaluate the effect of training in phonological awareness. It should also be noted, however, that in the study by Lundberg et al. (1988), the effect of the phonological awareness training on literacy was not evident until the children had been exposed to formal reading and spelling instruction a year later in first grade. It appears that once letter-sound relationships were introduced in first grade, the phonological awareness training the children had had in kindergarten gave them an edge over the control children that was apparent in their superior reading and spelling scores at the end of grade two. By dem-

onstrating that phonological awareness can be heightened outside the context of reading instruction, and that this awareness has an impact on the acquisition of reading and spelling once formal instruction begins. Lundberg and his colleagues have added support to a causal link between phonological awareness and reading acquisition—an important theoretical contribution. However, it does not necessarily follow that instruction in phonological awareness is *best* when provided outside the context of formal reading instruction, or that one should isolate these phonological awareness activities from activities that help children make connections between sound segments and letters. The next group of studies demonstrates the value of phonological awareness instruction that also incorporates letter-sound training.

Phonological Awareness Instruction that Makes Explicit the Connections Between Sound Segments and Letters. In a ground-breaking longitudinal and experimental training study in England, Bradley and Bryant (1983, 1985) not only established a causal relationship between phonological awareness and reading and spelling acquisition, but they also demonstrated the value of creating a link between the segmented sound units and and their corresponding printed symbols. In their longitudinal study, Bradley and Bryant found a significant relationship between the performance of 368 four- and five-year-olds on a sound categorization task and the reading and spelling of these same children three years later. An experimental training study was also conducted with 65 of these children who had low pretest scores on the sound categorization pretest. These children were randomly assigned to one of four groups matched on age, sex, IQ, and sound categorization ability. Children in the first group participated in 40, individually administered lessons spread over two years, during which they learned to categorize or group pictures on the basis of shared sounds. For example, the children were taught that *hen* could be grouped with *men* and *pen* because they rhymed, and also that *hen* could be grouped with *hat* and *hill* because they shared an initial sound. The children later worked on recognizing shared middle and final sounds. A mainstay of the program was a game called "the odd one out." Pictures of objects that rhymed or shared an initial, middle, or final sound were placed on the table, along with one picture that did not belong. The children were asked to identify the "odd one out" and to explain their choice. Children in the second experimental group also received the identical instruction in sound categorization that was provided to the first group, but this group also learned to represent the common sounds with plastic letters. For example, using the words *pen* and *hen*, the letters common to both words stayed on the table, while the children changed the *p* to an *h*. In the third group, established to control for the "special attention" provided to the children in the first two groups, the children also participated in 40 individually administered lessons spread over two years and practiced categorizing the same pictures used by the treatment groups. However, the children in this group were taught to categorize the pictures on the basis of semantic categories (e.g., *hen* and *dog* were grouped together because both are animals). The fourth group received no intervention.

The research of Bradley and Bryant has both theoretical and practical significance. Their results indicated that, although the children trained in sound categorization outperformed the children who did not receive this training, the most successful children were those who were trained in sound categorization and who also learned to represent the common sounds with plastic letters. These children had significantly higher reading and spelling scores than the children in the two control groups, and they also had significantly higher spelling scores than the children in the sound categorization only group. Recalling that the training consisted of only 40, 10-minute lessons spread over two years, it is even more impressive that in a follow-up study (Bradley 1988), conducted four years after the original study ended, children who learned to make the connections between sound categories and letter strings maintained their superior position in reading and spelling.

Although the Bradley and Bryant study answered some important questions by exploring the incremental benefit of connecting the sound segments to letters during the phoneme awareness instruction, their study also raised a new question. Because these researchers did not include a group that received only letter training, it was not possible to determine whether the *combination* of sound categorization plus letter training made the difference in reading and spelling achievement, or whether the letter training component itself was responsible for the superior performance on reading and spelling measures.

To answer this question, and also to explore the feasibility of working with groups of kindergarten children (rather than providing one-to-one instruction as in the Bradley and Bryant study), we (Ball and Blachman 1988, 1991) embarked on a phonological awareness training study in three, inner-city schools in a large urban district in upstate New York. Ninety kindergarten children were randomly assigned to one of three groups. The first group of children received instruction in phoneme segmentation and also in letter names and sounds. The second group of children (control group I) received instruction in a variety of language activities (such as having stories read to them and general

vocabulary development) and also received instruction in letter names and sounds using the same letter stimuli that were used by our treatment group. The third group was a no intervention control group. The children in the phoneme segmentation group and the language activities control group met in groups of four or five, four times a week for seven weeks, for 15 to 20 minute lessons. The lessons were taught outside the regular classroom by specially trained teachers.

The children in the phoneme awareness group followed a scripted, three-part lesson plan. At the beginning of each lesson, the children engaged in an activity called *say-it-and-move-it* (adapted from Elkonin 1963, 1973). Using a variety of manipulatives, such as disks, tiles or blocks, the children learned to move the appropriate number of disks to represent the number of sounds in a one-, two-, or three-phoneme word. Initially, children represented one sound with one disk. The teacher would say, "Show me /i/" (or, for example, /a/ or /s/). The children would repeat the sound slowly, and as they were repeating it they would use one finger to move one disk from the top half of an 8½" by 11" sheet to the left end of an arrow (drawn from left to right) on the bottom half of the page. When the children were successful at representing one sound with one disk, the teacher moved on to one sound repeated twice, such as /i/ /i/. Again, the children repeated the sounds and represented each sound with a disk. Next, two phoneme words (e.g., *it, up*) were introduced and segmented following the same procedure. After modeling by the teacher, the child repeated the word slowly, moving a disk to represent each sound. After success with two-phoneme items, three-phoneme items were introduced, being careful initially to select words that begin with continuous sound letters (letters that can be held with a minimum of distortion) (e.g., *sun, lip, fan*). After the third week of say-it-and-move-it activities, a limited number of letters that had previously been mastered by the children were added to the blank tiles. Each item to be segmented during that lesson contained only one of the letter tiles. Children now had the option of segmenting each word using all blank tiles, or using a combination of one letter tile and blank tiles to represent the sound segments in the word.

The second activity each day was selected from a variety of *segmentation-related activities*. For example, the teacher might select a sound categorization game adapted from Bradley and Bryant (1983, 1985). Using pictures of words that rhymed or that shared initial, final, or medial sounds, the teacher would display three pictures with shared sounds and one picture that did not belong. The children would select the one that did not belong and explain their choice. An

alternative activity was what Elkonin, a Russian psychologist, called "sound analysis" (1963, 1973). The children were given a picture of a word to be segmented (e.g., *leg*) and were taught to move disks into boxes at the bottom of the page as the word was pronounced slowly. The number of boxes corresponded to the number of sound segments in the word. In another segmentation-related task, children learned to hold up a finger for each sound in a spoken word. The children also had an opportunity to practice blending activities by correcting "mistakes" made by a puppet who told stories and sometimes mispronounced key words by segmenting them.

The third activity in each lesson emphasized *letter names and sounds*. The nine letters that were introduced during the seven week training (*a, m, l, i, s, r, u, b, f*) were selected because they generate a substantial number of real words. These letters, as well as illustrations of key words and phrases, were presented on 8½" by 11" cards. For example, the *r* card depicted a *r*ed *r*ooster in *r*ed *r*unning shoes. A variety of games that emphasized these sound-symbol associations were introduced, and the children played one game each day (e.g., a Bingo game was used that required the child to match the letter on the game board to a spoken sound or the initial sound of a pictured object).

As indicated earlier, the children in the language activities control group spent the same amount of time in their small groups as the phoneme awareness children. However, in the language activities group, the children worked on more general language activities, such as vocabulary development and listening to stories. In addition, the children in this group completed *letter name and letter sound* activities that were identical to those just described for the phoneme awareness children.

Prior to the intervention, the three groups of children did not differ on age, sex, race, SES level, phoneme segmentation, letter name knowledge, letter sound knowledge, or reading ability as measured by scores on the Word Identification Subtest of the Woodcock Reading Mastery Tests. After the intervention, the phoneme awareness group outperformed both control groups on phoneme segmentation, on reading (as measured by the word identification subtest of the Woodcock and a list of 21 phonetically regular words developed for this study), and on a developmental spelling test created for this study. It is important to note that, after the intervention, both the phoneme awareness group and the language activities group did not differ from each other on letter sound knowledge (both groups had received identical instruction in letter sounds), and both groups significantly out-

performed the no intervention control group on letter sound knowledge. However, only the phoneme awareness group significantly outperformed the no intervention control group in phoneme segmentation, reading, and spelling. An increase in letter sound knowledge, by itself, did not appear to have an impact on phoneme segmentation, reading, or spelling. We conclude that it is the *combination* of phoneme awareness training and learning to connect the sound segments to letters that makes a difference.

Thus, we now had additional evidence to document the positive effect on reading and spelling of training groups of kindergarten children in phoneme awareness. However, in this study (Ball and Blachman 1988, 1991) and in several of the others reviewed (Bradley and Bryant 1983, 1985; Cunningham 1990), the children received their instruction outside the regular classroom from specially trained teachers who were brought to the schools by the researchers. If we believe that instruction in phoneme awareness is an important ingredient in the kindergarten classroom, as many have suggested (see, for example, Adams 1990; Blachman 1989; Juel 1988), then we need to demonstrate the effectiveness of these activities when they are provided by regular kindergarten teachers to small groups of children within their classrooms.

To investigate this model of instruction, I received a three-year grant from the National Center for Learning Disabilities (formerly the Foundation for Children with Learning Disabilities) and embarked on a project to train inner-city kindergarten teachers and teaching assistants to provide this instruction in their classrooms (Blachman et al. 1991). Eighty-four treatment children (drawn from all 10 of the kindergarten classrooms in two low-income, inner-city schools in upstate New York) and 75 control children (drawn from all 8 of the kindergarten classrooms in two demographically comparable schools) participated in the study. The kindergarten teachers and teaching assistants participated in a series of seven, two-hour inservice workshops to learn how to provide the phoneme awareness program. During the workshops, they had opportunities to practice activities to use in their classrooms and to share questions and concerns about the program and the needs of individual children.

The treatment children met in small groups of four or five in their regular classrooms, with either their kindergarten teacher or teaching assistant providing the intervention (adapted from Ball and Blachman 1988, 1991). Each small group met for 15 to 20 minutes a day, four days a week for 11 weeks, and each phoneme awareness lesson consisted of the three steps previously described: *say-it-and-move-it, a segmentation-related activity, and letter name and letter sound training*. Because the intervention in this study was an expanded version of our earlier program (this intervention was eleven weeks instead of seven), we were able to extend the *say-it-and-move-it* activities by using more letter tiles during the last three weeks of the intervention. Whereas in the earlier study (Ball and Blachman 1988, 1991) children used, at most, one letter tile plus blank tiles to represent a three-phoneme word, some children in this study progressed to using letter tiles to represent each sound in a three-phoneme real word (e.g., *sat*). Children without mastery of letter sounds continued to use blank tiles throughout the intervention.

To have a better appreciation of the children involved in this study, it is important to remember that both groups (as stated earlier) were from comparable low-income, inner-city schools (86% of the treatment children and 83% of the control children received free or supported lunch). Prior to the intervention, the children in the two groups did not differ on age, sex, race, SES, phoneme segmentation, letter name knowledge, letter sound knowledge, or reading (as measured by the Word Identification Subtest of the Woodcock Reading Mastery Tests–Revised). In addition, both groups had extremely limited knowledge of the alphabet prior to the intervention, demonstrating knowledge on our pretest of an average of only two letter sounds. Yet, after the intervention, the treatment children significantly outperformed the control children on phoneme segmentation, letter name knowledge, letter sound knowledge, two of three reading measures, and a measure of invented spelling. Specifically, the treatment children were able to read more phonetically regular real words and nonwords (added to control for the small pool of real words some children were exposed to during the last few weeks of the intervention) and to represent more of the sounds in the five words dictated on our developmental spelling measure (lap, sick, pretty, train, and elephant). Thus, the treatment children were able to apply their skill in phoneme awareness, along with their awareness of how the sound segments connect to print, to beginning reading and writing activities. For example, when asked to spell the word *sick*, although none of the treatment or control children spelled it correctly, 32% of the treatment children represented all of the phonemes with conventional letters (e.g., *sik, sic*). None of the control children achieved this level of representation. The treatment children appeared to have at least a beginning understanding of how print maps to speech—an understanding that had yet to be achieved by the control children. Perhaps most important is the fact that the treatment children were taught in their regular classrooms by their kindergarten

teachers and teaching assistants, as part of an otherwise typical kindergarten curriculum, before any of the children had an opportunity to fail in reading and spelling.

After Phonological Awareness—Then What?

Once a level of phonological awareness has been achieved (as measured, for example, by the ability to segment one-, two-, and three-phoneme items), where do we go next? We chose to follow our kindergarten phoneme awareness program with a first grade reading program that would explicitly build on this awareness (Blachman et al. in preparation). After a review of the segmentation and blending activities introduced in kindergarten, our first graders followed a five-step, code-emphasis reading lesson that had been used successfully in other inner-city schools (Blachman 1987). This program was developed specifically to provide classroom teachers with an alternative to programs, such as a traditional basal program, which often ignore the alphabetic principle.

The treatment children met with their first grade teachers each day and participated in a five-part reading lesson.

1. First, teachers briefly reviewed sound-symbol associations with the children (spending only two or three minutes on this activity). It was during this part of the lesson that a new sound was introduced.
2. Next, the teacher emphasized phoneme analysis and blending skills using a technique suggested by Slingerland (1971) to help children synthesize sounds without resorting to letter-by-letter blending. Each child used a small pocket-chart, called a sound board, to manipulate letters. The teacher slowly pronounced a word, such as *sat*, emphasizing the medial vowel. The child repeated the word, listened for the vowel, and then selected the appropriate letter (the vowels were color-coded to facilitate recognition) from the top pocket and moved it to the lower tier of the chart. The teacher then repeated the entire word and asked the child to locate the letter that represented the initial sound and then locate the letter that represented the final sound. The child then read the entire word. The teacher might then ask the children to change *sat* to *sam*, *sam* to *sad*, and *sad* to *mad*. Once new vowels were introduced, the children might be asked to change *sat* to *sit* and later, when blends were introduced, change *sit* to *slip*. Although one child was called on initially, all children in the group could make the words at the same time on their sound boards.
3. Once children could construct a pool of phonetically regular words on the sound board (e.g., closed syllable words, such as *tag* and *lap*), these words were put on flash cards to be practiced for automatic recognition. High-frequency sight words (e.g., *said*) were also introduced at this point in the lesson. Again, as with the review of sound-symbol associations (step 1 in this lesson plan), this step of the lesson was also meant to be a brief review (2 to 3 minutes) to help children get ready to read these words in context.
4. The next step in the lesson was story reading. This step was emphasized, both in terms of time spent reading each day and also opportunities to read. For example, if a teacher had time to do only part of the lesson on a given day, story reading was the recommended focus of that lesson. The children used phonetically controlled readers (*Primary Phonics* series from Educators Publishing Service), stories from basal readers (the workbooks were not used), and popular trade books.
5. Finally, each lesson ended with a written dictation activity using words that had been produced earlier on the sound board and also words and sentences from the phonetically controlled readers. Once the children could comfortably read closed syllable words (e.g., *jet*, *hat*), the other five syllable patterns were introduced one at a time (i.e., open syllables, such as *be* and *my*; final "e" syllables, such as *hike* and *plane*; vowel team syllables, such as *rain*, *coat*, and *moist*; vowel plus "r" syllables, such as *car* and *corn*; and consonant *le* syllables, such as *table* and *handle*). The control children used a traditional basal reading program that emphasized whole-word memorization and did not provide the same systematic instruction in breaking the code.

At the end of the first grade year, the treatment children, who had now completed both the kindergarten phoneme awareness program and a first grade reading program that emphasized the alphabetic code, significantly outperformed the control children on posttest measures of phoneme segmentation, letter names, letter sounds, three measures of reading, our developmental spelling test (expanded to ten words), and a standardized spelling measure. In addition, fewer children in the treatment group were retained at the end of first grade, and fewer treatment children were referred for Chapter I remedial reading classes. Children who completed the code-emphasis program (either at the end of first grade or during their second grade year) were then placed in the basal program used by the school district. Thus, once the code-emphasis program was completed, our original treatment children began to receive the same reading instruction as the control children. We are continuing to monitor the reading achievement of the

children who were in our original treatment and control groups. Our preliminary results from testing, conducted at the end of the second grade year, indicate that the significant reading superiority of the treatment children has been maintained. For the children involved in our study (a population of low-income children from inner-city schools, who had limited knowledge about the alphabet prior to their kindergarten participation in this study), an early emphasis on phonological awareness, followed by a code-emphasis approach to reading in first grade, has resulted in reading achievement that is significantly greater than that of the children who did not participate in this program.

PROVIDING FOR INDIVIDUAL DIFFERENCES IN PHONOLOGICAL AWARENESS

There are, of course, many options for the type of reading program that follows an early emphasis on phonological awareness, and more of the options need to be carefully evaluated. What would appear to be crucial, however, is that "teachers understand the need to provide for individual differences in the phonological abilities that are required for reading in an alphabetic system" (Liberman and Shankweiler 1991, p. 14). This means, for one thing, making sure that all children learn about the segmental nature of speech and how print maps to speech. Although many children will make these discoveries on their own, by playing oral language games, such as rhyming (Maclean, Bryant, and Bradley 1987; Bryant et al. 1989), by repeated opportunities to connect printed and spoken words when being read to, and by opportunities to write, many other children will not be so fortunate. Some children will not have the necessary preschool exposure to language play and early literacy experiences that trigger these associations. Still other children, because of differences or deficiencies in phonological ability (many of whom may be labeled learning or reading disabled), will not discover the connections between print and speech on their own, *even* if they have the important preschool literacy experiences and opportunities to play with oral language. We have a responsibility to teach both groups of children, as well as those who are fortunate enough to learn to read regardless of the method.

An early emphasis on phonological awareness, using some of the activities described in this chapter, appears to put children in a better position to take advantage of reading and spelling instruction. Children who understand the segmental nature of speech, and who understand how the phonological segments are represented by the letters

of an alphabetic writing system, have been shown repeatedly to be more successful in reading and spelling acquisition than children who lack this awareness. As Juel (1988) found when she followed the reading development of 54 children from first to fourth grade, the poorest readers at the end of fourth grade were the ones who began first grade with little phonemic awareness. As a result, they did not develop good decoding skills in first grade. Without good word recognition skills, Juel found that these children were the ones who disliked reading and did less of it, losing valuable opportunities for vocabulary growth and for exposure to new concepts and ideas. This vicious cycle (described eloquently by Stanovich 1986) is what we would like to try to prevent, by making sure that all children develop the phonological awareness that will enable them to understand how print maps to speech.

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Vaccine War Emboldens India as It Weakens Polio

By JOHN F. BURNS

GAGANGAON, India, Jan. 20 — When the children of this village began to gather for polio vaccinations at the clinic near the pole-and-mud hut that is his home, Dewoo Hovaliya sat as he usually does on the warm, dry days of the Indian winter, naked on the bare earth before the hut.

Occasionally, the little boy looked toward the hubbub of women lining up with infants around the clinic, 100 yards away in a grove of casuarina trees. Then he returned to the lonely routine that occupies his days, squatting and scratching at the earth, bursting into tears when strangers come too close.

Dewoo, who is 8, is severely disabled, physically and mentally, by polio contracted when he was 1. On this recent morning his 2-year-old brother, Ajit, was among 120 million children across India who received drops of oral polio vaccine as part of a crash immunization program that has brought the country's incidence of polio tumbling down.

After years of inefficiency and delay that have left India with the highest incidence of polio of any nation, health officials agreed a year ago to adopt a new approach to polio eradication. Twice in the last six weeks (because two doses of the oral drops are required), hundreds of thousands of health workers and volunteers fanned out across India, into virtually every urban neighborhood and every village, to vaccinate the country's small children.

International health experts are confident that the new approach, begun in December 1995, has put India on a course to join scores of other nations that have wiped out polio. This would be a crucial step toward a polio-free world by 2000, a goal proclaimed by the World Health Organization a decade ago.

But for Dewoo, the polio victim in this village 80 miles north of Bombay, the new approach has come too late.

"If I could have immunized my child," said Vavuradika Hovaliya, the boy's father, "he would have been walking on his own feet, playing with other children."

Polio, a spinal inflammation, causes fever and paralysis often resulting in permanent disability and deformity. Vaccines against it have been available in India for at least 20 years under an immunization program run by health authorities.

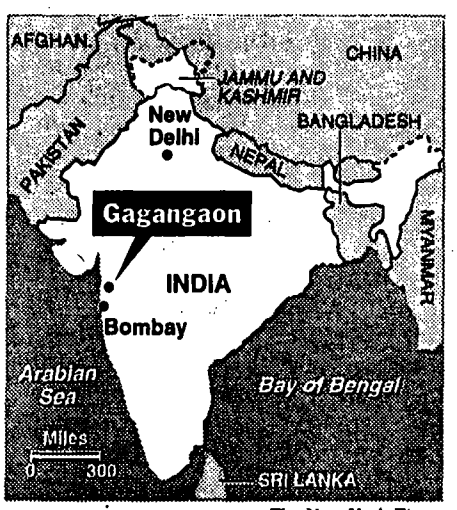
But official assertions that the regular program has reached more than 90 percent of Indian children have been shown to be greatly exaggerated, especially in the 650,000 villages where two-thirds of Indians live. Mr. Hovaliya said he had never heard of a polio vaccine until the new program came to this village for the first time 13 months ago.

It has been more than 40 years since Dr. Jonas Salk developed an injectable polio vaccine. And Dr. Albert Sabin's invention of an oral vaccine in the 1950's made it possible to mount an effective attack on the virus, one of the greatest human health scourges. In many parts of the world, the disease has been eradicated through mass immunization, particularly of small children, who are the most susceptible.

W.H.O. estimates that at least half of all new cases each year occur in India, which makes it one of the last bastions of the disease. At least 25 million Indians have been severely disabled by polio in the last 25 years. But if the fast-falling rates achieved by the crash immunization are sustained, health experts say the country might be polio-free in two or three years.

John F. Burns/The New York Times

On "immunization day" this month, scenes like this were common throughout India as 120 million children were vaccinated for polio. Poor sanitation and a hot climate make India one of the last bastions of the disease.



The New York Times

Gagangaon was one of hundreds of thousands of vaccine sites.

In the meantime India and its immediate neighbors remain the biggest challenge. The health agency estimates that of 100,000 new polio cases reported from about 60 countries each year, 80 percent occur in India, Bangladesh, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand. Another 150 nations, including those of North and South America and Western Europe as well as China and Australia, have been certified as polio-free.

What this means, according to epidemiologists like Dr. Jon Andrus, a 44-year-old American who monitors the polio eradication program for W.H.O. from New Delhi, is not that these countries have no polio, but that there are no new cases resulting from "indigenous transmission" between long-term residents.

Health experts say one reason India and its neighbors have the highest incidence of polio is their hot, humid climate, which provides ideal breeding conditions for the virus. Poor sanitation, traditionally one of India's greatest health problems, has made its children particularly vulnerable, as they are too young to take basic precautions against a virus that attacks through oral contamination. A lack of toilets and sewage systems forces hundreds of millions to defecate on open ground, often near homes and water sources, or among crops.

A decline in polio has fed optimism about conquering other diseases.

Still, the plunging rates since the adoption of the crash program have bolstered confidence. Figures compiled by state governments show the number of reported cases falling to 742 in the first nine months of 1996, after the first round of mass immunizations, from 2,643 in the same period in 1995. A decade ago, nearly 30,000 cases were being reported every year.

W.H.O. estimates that the actual number of polio cases across countries like India, with large territories and partly monitored populations, may be up to 10 times higher. Even so, Indian health workers see the trend in official figures as evidence that eliminating the disease is well within reach. "We know now that the world is going to eradicate polio," Dr. Andrus said. "And one of the reasons we are so confident is because we are sure now that we can eradicate it in India."

When the crash polio immunization program was first proposed, Indian officials demurred, citing a lack of resources, although the average cost of immunizing an Indian child is about 30 cents.

"The general response among Indian health officials to the success stories of similar campaigns elsewhere was, 'But this is India,' " Dr. Andrus said. But he added that success was fostering optimism. "What has been accomplished with the polio campaign has been a tremendous eye-opener."

The partnership that has made the campaign possible has brought together hundreds of thousands of Indian health workers and volunteers affiliated with W.H.O., the United Nations Children's Emergency Fund and the United States Centers for Disease Control and Prevention. Financial support has also come from the governments of Japan and several European nations, including Britain, Denmark, Germany and Norway.

But much of the credit for the campaign, in India and elsewhere, goes to Rotary International, the Chicago-based network of clubs for business and professional people, which has raised more than $300 million to fight polio around the world. It has spent more than $30 million in India, a larger sum than the Indian Government itself has spent to eradicate the disease over the decades.

For the most recent immunization day in India, Rotary mobilized its 70,000 members here, and tens of thousands of other volunteers. Their many contributions included the vital one of helping maintain the "cold chain," the refrigeration essential to the vaccine's effectiveness.

Success has renewed hope that India may one day overcome other chronic health problems, including epidemic levels of diarrhea, malaria and tuberculosis, which kill tens of thousands every year.

"We in India have been slow, lethargic and inefficient in tackling our problems," said Raja Saboo, 62, a Punjabi industrialist who is chairman of the Rotary Foundation, Rotary International's charitable arm. "But polio immunization has shown one thing: that if you have a good cause and a committed leadership, we can do it. We have the capacity to rise to the occasion."

'Whenever and Wherever We Choose' *The Replication of 'Success for All'*

The authors present data demonstrating that substantially greater success for disadvantaged students can be routinely ensured in schools that are neither exceptional nor extraordinary.

BY ROBERT E. SLAVIN, NANCY A. MADDEN, LAWRENCE J. DOLAN
BARBARA A. WASIK, STEVEN M. ROSS, AND LANA J. SMITH

FIFTEEN years ago, Ronald Edmonds put forth a proposition that has served as the touchstone of the school effectiveness movement ever since: "We can, whenever and wherever we choose, successfully teach children whose schooling is of interest to us."[1] This proposition has two parts: one is the assertion that every child can learn; the other, that we have the knowledge we need to create schools in which every child will learn.

Can every child learn? Research has demonstrated that at-risk students can achieve at far higher levels than they have in the past. For example, research on early intervention and research on one-to-one tutoring demonstrate the principle that virtually every child can learn.[2] Extraordinary teachers and schools prove every day that they are able to produce extraordinary outcomes with disadvantaged and minority children.

While it is becoming clear that every child can learn, there is a part of Edmonds' formulation that is more problematic. Is it really true that we can ensure the learning of every child "whenever and wherever" we choose? Demonstrations of outstanding learning achievements in laboratories or in schools with unusual, charismatic principals and teachers are useful, but they do not tell us that success can be replicated on a large scale. Many pilot programs have shown substantial success, but that success has proved difficult to replicate. Clearly, it is not enough to demonstrate success and expect others to do likewise. For a program or strategy to make a difference on a broad scale, it must be robust under many circumstances, it must withstand the test of time, and it must demonstrate effectiveness in new sites that are not under the day-to-day control of the program developers.

In this article we present a summary of data from Success for All, a program that is now in the process of making the transition from local pilot to national model. This is the first report to present data on several sites beyond the original home of Success for All in Baltimore. Earlier evaluations of the program have shown that it can be highly successful in increasing reading achievement among very disadvantaged students.[3] Can this success by replicated whenever and wherever we choose?

It is important to state up front what we mean by "we." No one can pretend that researchers, developers, or government agencies can by themselves ensure the success of all students. The enthusiastic and wholehearted commitment of school staffs and district administrators is also essential. In the case of Success for All, we work only with school staffs that have voted at least 80% in favor of participating and districts that have made a clear commitment to implement the program.

Success for All began in Baltimore in 1986. It was designed in a collaboration between our group at Johns Hopkins University and the Baltimore City Public Schools and piloted in one school in the 1987-1988 school year. Since then, Success for All has expanded both within and outside Baltimore and is currently being implemented in a total of 100 schools in 40 school districts in 20 states from coast to coast, including Canada. From the outset, the program has emphasized rigorous evaluation of its results in comparison with those of matched control schools in the same districts, preferably through the use of individually administered tests of reading. Due to funding limitations, not all Success for All schools are being assessed in this way, but we currently have high-quality assessment data from 15 schools in seven districts in seven states, a remarkable body of evidence for an innovative program. Three of the districts were evaluated by Johns Hopkins staff members, and four (using identical measures and procedures) were evaluated by an independent group at Memphis State University. This article summarizes the findings from these seven districts, plus two that have done their own evaluations using routinely administered standardized tests.

ELEMENTS OF SUCCESS FOR ALL

Our basic approach to designing a program to ensure the success of all disadvantaged children begins with two essential principals: prevention and immediate, intensive intervention. That

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Tutors support students' success in the regular reading curriculum, rather than teaching different objectives.

is, learning problems must be prevented by providing children with the best available classroom programs and by engaging parents in support of their children's school success. When learning problems do appear, corrective interventions must be immediate, intensive, and minimally disruptive to students' progress in the regular program. Thus students receive help early on, when their problems are small. The help is intensive and effective enough to catch students up with their classmates, so that they can profit from their regular classroom instruction.

Instead of letting students fall further and further behind until they need special or remedial education or are retained in grade, Success for All gives them whatever they need to keep up the basic skills as soon as they need it. Typically, Success for All does not require significant additional expenditures, but rather shifts existing Chapter 1, special education, and other dollars from remediation to prevention and early intervention. The elements of Success for All are described below.[4]

Reading tutors. One of the most important elements of the Success for All model is the use of one-to-one tutoring – the most effective form of instruction known – to support students' success in reading.[5] The tutors are certified teachers with experience teaching Chapter 1, special education, and/or primary-level reading. Tutors work directly with individual students who are having difficulty keeping up with their reading groups. The students are taken from their homeroom classes by tutors for 20-minute sessions during times other than reading or math periods. In general, tutors support students' success in the regular reading curriculum, rather than teaching different objectives. For example, if the regular reading teacher is working on stories with long vowels or is teaching strategies to monitor comprehension, so does the tutor. However, tutors seek to identify learning deficits and use different strategies to teach the same skills.

During daily 90 minute reading periods, tutors serve as additional reading teachers to reduce the size of reading classes. Brief forms carry information on students' specific deficits and needs between reading teachers and tutors, and reading teachers and tutors meet regularly to coordinate their approaches with individual children.

The initial decisions about placements in reading groups and the need for tutoring are made according to the results of informal reading inventories given to each child by the tutors. Subsequent changes in reading group placements and tutoring assignments are made according to outcomes of eight-week assessments, which include teacher judgments as well as more formal assessments.

First graders receive priority for tutoring, on the assumption that the primary function of the tutors is to help all students be successful in reading the first time, before they become remedial readers.

Reading program. For most of the day, students in grades 1 through 3 are assigned to heterogeneous, age-grouped classes of about 25. But during a regular 90-minute reading period, they are grouped into reading classes of 15 students who are all performing at the same reading level. For example, a first-semester, second grade reading class might contain first, second, and third grade students, all reading at the same level.

Regrouping allows teachers to teach the whole class without having to break the class into reading groups. This greatly reduces the time spent on seatwork and increases the time available for direct instruction. We do not expect reduction in class size to increase reading achievement by itself,[6] but the small classes ensure that every reading class will be working at one level, which eliminates many of the workbooks, dittos, and other follow-up activities that are needed in classes with multiple reading groups. The regrouping is a form of the Joplin Plan, which has been found to increase reading achievement in the elementary grades.[7]

The reading program itself has been designed to take full advantage of having 90 minutes of direct instruction. The program emphasizes the development of basic language skills and sound- and letter-recognition skills in kindergarten. It uses an approach based on sound blending and phonics starting in first grade (although kindergarten students who show readiness may be accelerated into the first grade program if the school chooses). Students in pre-K, kindergarten, and first grade use the Peabody Language Development Kits to help them build language concepts essential to later reading success.

The K-1 reading program uses a series of "shared stories," in which part of the story is written in small type and read by the teacher, while part is written in large type and read by students. The student portion uses phonetically controlled vocabulary. The program emphasizes oral reading to student partners as well as the teacher, instruction in story structure and specific comprehension skills and integration of reading and writing. When they reach the primer reading level, students use a form of Cooperative Integrated Reading and Composition (CIRC) with novels or basals. CIRC uses cooperative learning activities built around story structure, prediction, summarization, vocabulary building, decoding practice, writing and direct instruction in reading comprehension skills.

Eight-week assessments. Every eight weeks, reading teachers assess students' progress through the program. The results of these assessments are used to determine who is to receive tutoring, to suggest adaptations in students' programs, and to identify students who need other types of assistance, such as family interventions or vision/hearing screenings.[8]

Preschool and kindergarten. Most Success for All schools provide a half-day preschool and/or a full-day kindergarten for all eligible students. The preschool and kindergarten provide a balanced and developmentally appropriate learning experience for young children. The curriculum emphasizes the development and use of language and provides a mix of academic readiness and music, art, and movement activities. Readiness activities include the use of integrated thematic units, Peabody Language Development Kits, and a program called Story Telling and Retelling (STaR) in which students retell stories read by teachers.

Family support team. A "family support team" that consists of any social workers, parent liaisons, counselors, and others who work in the school provides parenting education and makes an effort to involve parents in support of their children's success in school. In addition, family support staff members lend

A full-time program facilitator works at each school to oversee (with the principal) the operation of Success for All.

assistance when there are indications that students are not working up to their full potential because of problems at home. For example, families of students who are not receiving adequate sleep or nutrition, who need glasses, who are not attending school regularly, or who are exhibiting serious behavior problems receive assistance from the family support team. Links with appropriate community service agencies are also forged to provide as much focused service as possible for parents and children.

Program facilitator. A full-time program facilitator works at each school to oversee (with the principal) the operation of Success for All. The facilitator helps plan the Success for All program, assists the principal with scheduling, and visits classes and tutoring sessions frequently to help teachers and tutors with individual problems. The program facilitator may work with individual children in order to find successful strategies for teaching them and then return them to the tutors or teachers. The facilitator also coordinates the activities of the family support team with those of the instructional staff.

Teachers and teacher training. The teachers and tutors are regular teachers. They receive detailed teacher's manuals, supplemented by two days of inservice training at the beginning of the school year and several inservice training sessions throughout the year on such topics as classroom management, instructional pace, and the implementation of the curriculum.

Special education. Every effort is made to deal with students' learning problems within the context of the regular classroom, as supplemented by tutors. Resource services for special education are still provided for students previously assigned to special education, but no new assignments to resource services are made for reading problems. The assumption is that the tutoring services available to all students will be more appropriate. Self-contained services are maintained for seriously handicapped students whose needs cannot be met by regular classrooms.

Advisory committee. An advisory committee composed of the building principal, facilitator, selected teachers and tutors, and parent representatives meets regularly to review the progress of the program and to identify and solve any problems that arise.

EVALUATION DESIGN

Success for All uses a common evaluation design, with variations to account for local circumstances. Every Success for All school involved in a formal evaluation is matched with a control school that is similar in poverty level percentage of students qualifying for free lunch, historical achievement level, ethnicity of the student body, and a variety of other factors. Children in the Success for All schools are then matched either by scores on district-administered standardized tests given in kindergarten or (starting in 1991 in several districts) by scores on the Peabody Picture Vocabulary Test (PPVT) given by the project in the fall of kindergarten or first grade. In some cases, analyses of covariance rather than matches of individual children were used, and, in the case of Key School in Philadelphia, the schools were matched but the individual children could not be matched (because the school serves many students with limited proficiency in English who were not tested by the district in kindergarten).

The measures used in the 1992 and 1993 evaluations of Success for All were as follows:

1. *Woodcock Reading Mastery Test.* Three Woodcock scales – word identification, word attack, and passage comprehension – were administered to the students by trained testers. Word identification assesses recognition of common sight words, word attack assesses phonetic synthesis skills, and passage comprehension assesses comprehension in context.

2. *Durrell Analysis of Reading Difficulty.* The Durrell oral reading scale was also administered individually. It presents a series of graded reading passages that students read aloud; the passages are followed by comprehension questions.

Except at Philadelphia's Key School, analyses of covariance with pretests as covariates were used to compare raw scores in all evaluations, and separate analyses were conducted for students in general and for students in the lowest 25% of their grades. At Key School analyses of variance were used and results were reported separately for Asian (mostly Cambodian) and non-Asian students.

The summaries of student performance are presented here in grade equivalents (adjusted for covariates) and effect sizes (proportion of a standard deviation separating the experimental and control groups), averaging across individual measures. Neither grade equivalents nor averaged scores were used in the analyses, but they are presented here as a useful summary. The outcomes for all students in the Success for All and control schools, as well as those for the students in the lowest 25% of their grades – those who are most at risk – are presented below. In most cases the lowest 25% was determined by scores on the PPVT that was given as a pretest. In Baltimore and in Charleston, South Carolina, however, PPVT pretests were not given, and the lowest 25% were chosen according to scores on the posttest.

Each of the evaluations summarized below compares children who began Success for All in first grade or earlier to children who attended the control school during the same period. Because Success for All is a prevention program, students who begin the program after first grade are not considered to have received the full treatment (although they are of course served within the schools). At this writing, data for spring 1993 were available from some sites, while 1992 data were used for others. The most recent data available are presented in each case.[9]

Baltimore. The original home of Success for All, Baltimore is the district with the longest longitudinal data base and the largest number of schools being evaluated. As of Spring 1992, the original pilot school had used the program for five years, and four additional schools had used it for four years. The student bodies at all the schools are almost entirely African American; from 75% to 96% of the students in each school are eligible for subsidized lunches.

Students in Success for All are performing significantly better than students in control groups at all grade levels from first to third. The effect sizes for each grade are: grade 1, +.31; grade 2, +.61; grade 3, +.53. As has been typical of Success for All evaluations, the effects have been particularly large for students who are in the lowest 25% of their

classes: grade 1, +.77; grade 2, +1.73; grade 3, +.87.

In addition to the effects seen on individually administered reading measures, Success for All has had an impact on several other measures. Among these are the standardized tests routinely administered by the district. On the Comprehensive Tests of Basic Skills (CTBS), no differences were found between Success for All and control students in first grade, but significant differences in favor of Success for All were found on the CTBS reading comprehension and language scales in second through fifth grades. We do not consider standardized test scores to be as reliable, valid, and relevant as the individualized measures, but we track them because of their importance to the district.

Evaluations of Success for All in Baltimore have also found positive effects on attendance. Retention in grade has been reduced from an average of 11% in grades K-3 to near zero. Avoiding retention is a policy of Success for All rather than an outcome of the program, but it is important to show that inner-city schools can get along without retaining large numbers of students. In 1992-93 three additional schools began using Success for All, and we are piloting a program to ease the transition to middle school for students graduating from Success for All elementary schools.[10]

Philadelphia. The first school district outside Baltimore to implement Success for All was Philadelphia. Francis Scott Key Elementary School, which serves a population that is majority Southeast Asian (mostly Cambodian) has been using the program since 1988. Three more schools began to implement Success for All in 1991. These are all very poor schools that serve primarily African American children, with nearly 100% of the students qualifying for subsidized lunches.

Asian students at Key School exceeded those in their control school by an average of more than a full grade-equivalent in first grade (ES = +4.69); Asian students in Success for All were reading above grade level, while their counterparts in the control schools were nonreaders, scoring near the bottom of the scale on all tests. Asian second graders at Key School exceeded their controls by more than a grade equivalent (ES = +1.67). Asian third graders (ES = +.47), and fourth graders (ES = +.37) exceeded control students by six and five months respectively. Non-Asian students at Key School outperformed their controls by an average of approximately 3.5 months in first grade (ES = +1.47), three months in second grade (ES = +.26), four months in third grade (ES = +.27), and five months in fourth grade (ES = +.24).

The results for two of the three Philadelphia schools that began Success for All in 1991 (data on the third school were lost) show that first graders in these schools were reading above grade level and two months ahead of their controls (ES = +.31). The lowest-achieving 25% of Success for All students were reading about at grade level and exceeded their controls by 3.5 months (ES = +.62).[11]

Charleston, South Carolina. Pepperhill Elementary School in Charleston began to use Success for All in the 1990-91 school year. Pepperhill is the only Success for All school being evaluated that is not a Chapter 1 school (although a school in Philadelphia that does not qualify as a Chapter 1 school adopted the program in 1992-93). Despite a poverty rate much higher than the national average (40% of students qualify for subsidized lunches and 60% are African American), Pepperhill does not qualify for Chapter 1 funding within the Charleston district. However, under the South Carolina Educational Improvement Act, it does receive state funds for compensatory education that pay for the cost of Success for All.

Still, because it is not a Chapter 1 school, Pepperhill has less money to implement Success for All than do other schools in the program. As a result, Pepperhill is the only school being evaluated that uses paraprofessionals rather than certified teachers as tutors. The paraprofessionals are of high quality: one is certified to teach in another state, and another has a four-year degree. Moreover, all received significantly more training than is given to tutors who are certified to teach. Pepperhill provides us with the first opportunity to evaluate Success for All in a school that has fewer dollars to spend and a relatively less needy population.

The outcomes for first graders at Pepperhill show a substantial positive effect of the program on student achievement. This school has the highest mean reading level of any Success for All school (a grade equivalent of 2.45), four months ahead of its control school. Effects were also quite positive for students in the lowest 25% of their grade.[12]

Memphis State evaluations. The evaluations of Success for All in Baltimore, Philadelphia, and Charleston are being conducted directly by our group at Johns Hopkins. Several additional evaluations are being conducted by an independent evaluation team led by Steven Ross and Lana Smith and working out of Memphis State University. These include evaluations in Memphis, in Fort Wayne, Indiana, in Montgomery, Alabama, and in Caldwell, Idaho.

The evaluations in three of the four districts studied by the Memphis State team found substantial positive effects of Success for All. In Memphis, first graders in an inner-city school were reading well above grade level (a grade equivalent of 2.1) and three months ahead of their matched controls (ES = +.38). Effects in second grade were substantial for the general student population (ES = +.51) and even stronger for those in the lowest 25% (ES = +2.66). Standardized test scores also favored Success for All students in reading comprehension.[13]

A study of two schools in Fort Wayne, Indiana, found strong positive effects of Success for All on student achievement. First graders were reading well above grade level (a grade equivalent of 2.45) and more than three months ahead of controls (ES = +.51). The lowest 25% of students were also reading above grade level and 4.5 months ahead of their control group (ES = +.79). Second graders were reading four months ahead of their controls (ES = +.44), and the lowest 25% of second graders were almost on grade level and more than four months ahead of their counterparts (ES = +.79).[14]

Two schools in Montgomery, Alabama, had the largest program effects of any first grade evaluation. Success for All first graders were reading more than five months ahead of their peers in the control group (ES = +1.32). Among the lowest 25%, control students were not reading at all, while Success for All students posted an average grade equivalent score of 1.46 (ES = +2.86).[15]

The only school that failed to show positive effects of Success for All is a school in rural Caldwell, Idaho. First graders in Caldwell performed no better than their control group. We find these results puzzling. Observations of program implementation indicated that the school was implementing Success for All with spirit and fidelity; in fact, this school was rated by our facilitators as one of the best implementations.

It is possible that the reason for the failure to find differences may have to do with the control school, not the Success for All school. Observers found that the matched control school was an extraordinary place – a new facility with an exceptionally able principal and staff. First graders at the Success for All school in Caldwell had some of the highest scores of any of our schools, with an average grade equivalent in reading of 2.22. In this case, however, the control first grad-

ers also had high scores (a grade equivalent of 2.18).[16]

DISTRICT EVALUATIONS AND POOLED OUTCOMES

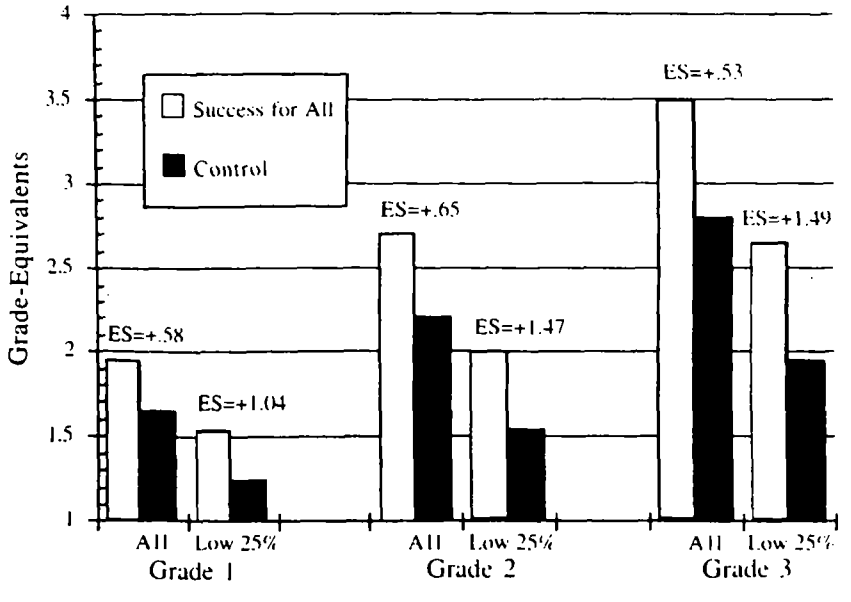
Some of the school districts implementing Success for All have sent us standardized test data. A school in Charleston, West Virginia, showed substantial gains in test scores and attendance and reduced its retentions to zero. A school in Wichita Falls, Texas, saw the percentage of third graders meeting minimum expectations on a state test increase from 48% to 70% in reading and from 8% to 53% in writing, while the rest of the district stayed at about the same level on both scales. Two schools in Modesto, California, made extraordinary gains in grades 1 through 3 on the Comprehensive Tests of Basic Skills.

In addition to analyzing the site-by-site results, we also used a method for combining the experimental/control comparisons over many replications and over time.[17] This technique – called a multisite replicated experiment – considers each successive group of students and each pair of experimental and control schools a replication. For example, across the 15 Success for All schools we have studied, 37 separate groups of first graders have experienced the program and have been assessed on individually administered reading measures. Twenty-one groups of second graders and 13 groups of third graders have been in the program since first grade. This pooling procedure is a minor variation on the kind of meta-analysis commonly used in medical research, and it allows us over time to build up a sample large enough to conduct school-level analyses of program effects.

Figure 1 shows the mean grade equivalents and effect sizes for all 15 Success for All schools and their control schools. For students in general, effect sizes averaged more than half a standard deviation each year, which means that the average Success for All child performs better than 70% of the control students. Analyses at the school level indicate that the effect sizes are significantly different from zero at all three grade levels ($p<.001$). Because standard deviations increase with each year in school, a constant effect size implies a growing difference in absolute or grade equivalent terms; Success for All students exceed matched control students by about three months in first grade but by almost seven months in third grade.

Effects for students in the lowest 25% of their groups are consistently larger than for students in general, averaging an effect size of +1.04 in grade 1, +1.47 in grade 2, and +1.49 in grade 3. By the end of third grade these low-achieving students are performing better than 93% of matched control students. These effect sizes are significantly different from zero ($p<.001$ in grades 1 and 2; $p<.004$ in grade 3). Larger effect sizes for lower-achieving students than for students in general have been found in almost every evaluation of Success for All. This is primarily a result of the tutoring, family support, and other services that are principally provided to the lowest-achieving students. A major goal of Success for All is to build a floor under the achievement of all students, and the large gains made by the lowest achievers are evidence that this is occurring.

Figure 1. Cumulative Mean Grade-Equivalents and Effect Sizes in Reading for 'Success for All' Schools, 1988-93



The longer a *school* is in the program, the better the effects on the reading performance of students in all grades.

PROGRAM EFFECTS OVER TIME

Data on the effects of Success for All in successive years of implementation are summarized in Figure 2.[18] These data clearly show that the longer a *school* is in the program, the better the effects on the reading performance of students in all grades. For example, in the first implementation year, Success for All first graders exceed their control counterparts by an effect size of +.34; this rises to +.57 for the second group of first graders, +.78 for the third, and +.82 for the fourth.

There are two likely explanations for the growth in improvement in successive years. One is that the schools simply get better with practice. Because Success for All involves so many changes, implementing all of them to a high degree of quality can take more than a single year. The second factor to consider is the fact that only in the second year have first graders participated in Success for All since kindergarten, and only in the third year have they participated since prekindergarten.

REPLICABILITY AND IMPACT

The results of evaluations of 15 Success for All schools in seven states clearly

show that the program improves student performance in reading. In all but one school, Success for All students learned significantly more than matched control students. Significant effects were not seen on every measure at every grade level, but the consistent direction and magnitude of the effects show unequivocal benefits for Success for All students. Evaluations for previous years have shown that Success for All has been effective in its original districts, Baltimore and Philadelphia. These new evaluations add evidence that the program can be replicated far from its original home with similar results.

The Success for All evaluations have used reliable and valid measures, consisting of individually administered tests that are sensitive to all aspects of reading, including comprehension, fluency, word attack, and word identification. Moreover, the performance of Success for All students has been compared to that of matched students in matched control schools. Replication of such high-quality experiments in such a wide variety of schools and districts is extremely unusual.

Although the outcomes on individually administered measures have the greatest validity and scientific importance, a number of other indicators point to the replicability and practical impact of Success for All. One indicator is standardized test scores, which were found to increase significantly in Baltimore, in Charleston, West Virginia, in Wichita Falls, Texas, and in Modesto, California. Another measure is the fact that most of the districts being evaluated (and many others as well) have expanded the program to additional sites after the initial pilots. An important indicator of the robustness of Success for All is the fact that, of the more than 70 schools that have used the program for periods of up to six years, only three have dropped out (in all cases because the principal changed). However, many other Success for All schools have survived changes of superintendents, principals, facilitators, and other key staff members.

There is nothing magic about Success for All. None of its components are completely new or unique. The first-year results in Caldwell, Idaho, which seem so puzzling on the surface, support the commonsense observation that schools serving disadvantaged students can have great success without a special program if they have an outstanding staff. Other prevention/early intervention models, such as Reading Recovery[19] and James Comer's School Development Program,[20] have also shown themselves to be effective with disadvantaged children. The main value of the Success for All research is not in validating a particular model or in demonstrating that disadvantaged students can learn. Rather, the findings' greatest importance is in demonstrating that substantially greater success for disadvantaged students can be routinely ensured in schools that are neither exceptional nor extraordinary – schools that were not producing great success before the program was introduced.

We cannot ensure that every school has a charismatic principal or that every student has a charismatic teacher. Nevertheless, we can ensure that every child, regardless of family background, has an opportunity to succeed in school.

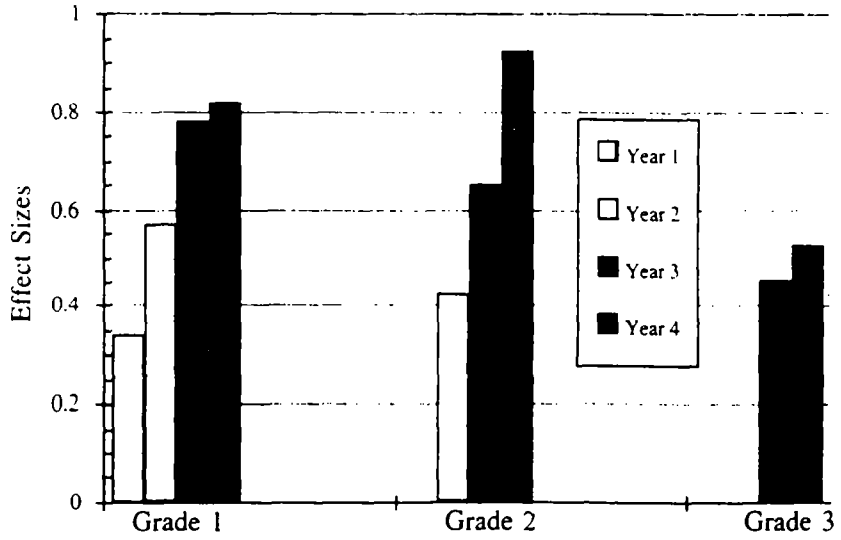
There is nothing magic about Success for All. None of its components are completely new or unique.

If Success for All were markedly more expensive than traditional programs, that would be a major practical limitation on its replicability. However, this is usually not the case. Additional funding to hire tutors does help ensure the success of *every* child. But, while two of the original Success for All schools did receive significant additional funds, none of the rest have. Schools with high enrollments of poor children usually have sufficient Chapter 1 funds to implement a credible form of the model, and these funds are often supplemented by reallocated funds or personnel from special education, state compensatory education, desegregation settlements, bilingual education, and other sources. Only one of the 15 schools in the longitudinal evaluation receives significantly more funding than its control school.

Demonstrating that an effective program can be replicated successfully removes one more excuse for the continuing low achievement of disadvantaged children. When Ronald Edmonds stated that we can successfully teach all children "whenever and wherever we choose," he may indeed have been right in principle. However, practical demonstrations of this principle are still essential. To ensure the success of disadvantaged students, we must have the political commitment to do so, along with the funds and policies to back up the commitment. We must also have methods known to be effective in their original sites and replicable and effective in other sites.

Success for All requires a serious commitment to restructure elementary schools and to reconfigure the uses of Chapter 1, special education, and other

Figure 2. Growth in Reading Effects in Successive Years of Implementation for 'Success for All' Schools, 1988-93*



*Includes all students who were in Success for All or control schools since first grade in seven districts.

funds to emphasize prevention and early intervention rather than remediation. It also requires a vote of at least 80% of teachers in favor of implementing the program. However, when a school makes such a commitment, it can succeed. The evidence summarized in this article offers practical proof that, "whenever and wherever we choose," we can successfully teach all children.

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2. Robert E. Slavin, Nancy L. Karweit, and Barbara A. Wasik, "Preventing Early School Failure: What Works," *Educational Leadership*, December 1992/ January 1993, pp. 10-18; idem, eds., *Preventing Early School Failure* (Boston: Allyn and Bacon, 1994); and Barbara A. Wasik and Robert E. Slavin, "Preventing Early Reading Failure with One-to-One Tutoring: A Review of Five Programs," *Reading Research Quarterly*, vol. 28, 1993, pp. 178-200.

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8. Robert J. Stevens et al., "Cooperative Integrated Reading and Composition: Two Field Experiments," *Reading Research Quarterly*, vol. 22, 1987, pp. 433-54.

9. For details on evaluation methods and findings, see Slavin et al., op. cit., and the full reports for individual sites (noted below).

10. For more on the Baltimore evaluations, see Madden et al., op. cit., and Slavin et al., op. cit.

11. For more on the Philadelphia evaluations, see Robert E. Slavin, *Success for All in the Philadelphia Public Schools: 1991-1992 Evaluation Report* (Baltimore: Center for Research on Effective Schooling for Disadvantaged Students, Johns Hopkins University, 1993).

12. Barbara A. Wasik and Robert E. Slavin, *Success for All at Pepperhill Elementary School: 1992 Evaluation* (Baltimore: Center for Research on Effective Schooling for Disadvantaged Students, Johns Hopkins University, 1993).

13. Steven M. Ross and Lana J. Smith, *Final Report: 1992-93 Success for All Program in Memphis, Tennessee* (Memphis State University, 1993).

14. Lana J. Smith and Steven M. Ross, Final Report: 1992-93 *Success for All Program in Ft. Wayne, Indiana* (Memphis: Memphis State University, 1993).

15. Steven M. Ross et al., *Final Report: 1992-93 Success for All Program in Montgomery, Alabama* (Memphis: Memphis State University, 1993).

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19. Gay Su Pinnell, "Reading Recovery: Helping At-Risk Children to Read," *Elementary School Journal*, vol. 90, 1989, pp. 161-82.

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NOTE: This article was reprinted from *Phi Delta Kappan*, April 1994, pages 639-647.

SPECIAL REPORT

FERTILE MINDS

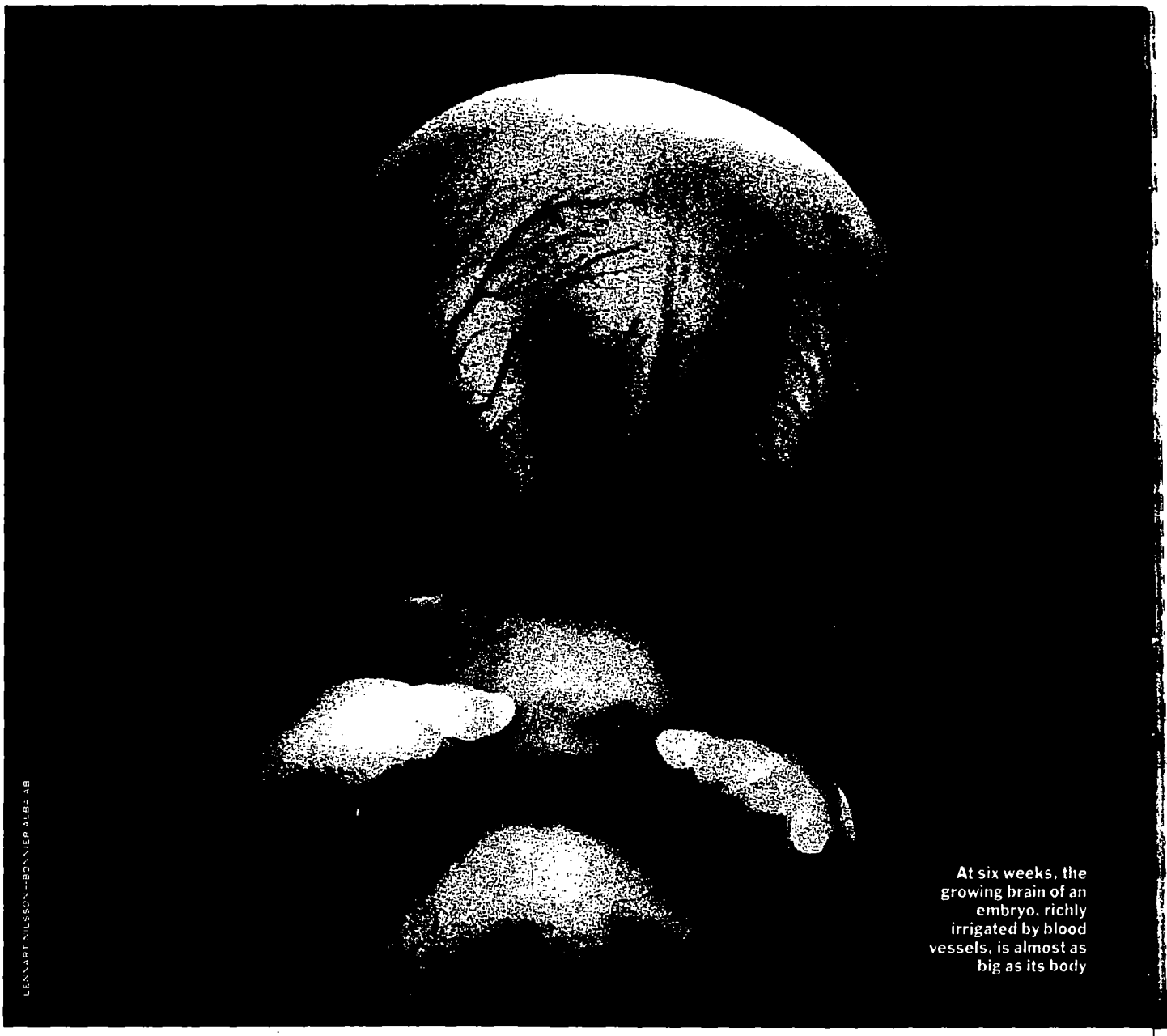
From birth, a baby's brain cells proliferate wildly, making connections that may shape a lifetime of experience. The first three years are critical

By J. MADELEINE NASH

RAT-A-TAT-TAT. RAT-A-TAT-TAT. RAT-A-TAT-tat. If scientists could eavesdrop on the brain of a human embryo 10, maybe 12 weeks after conception, they would hear an astonishing racket. Inside the womb, long before light first strikes the retina of the eye or the earliest dreamy images flicker through the cortex, nerve cells in the developing brain crackle with purposeful activity. Like teenagers with telephones, cells in one neighborhood of the brain are calling friends in another, and these cells are calling their friends, and they keep calling one another over and over again, "almost," says neurobiologist Carla Shatz of the University of California, Berkeley, "as if they were autodialing."

But these neurons—as the long, wiry cells that carry electrical messages through the nervous system and the brain are called—are not transmitting signals in scattershot fashion. That would produce a featureless static, the sort of noise picked up by a radio tuned between stations. On the contrary, evidence is growing that the staccato bursts of electricity that form those distinctive rat-a-tat-tats arise from coordinated waves of neural activity, and that those pulsing waves, like currents shifting sand on the ocean

Photograph by Anne Geddes



LENNART NILSSON—BONNIER ALBA AB

At six weeks, the growing brain of an embryo, richly irrigated by blood vessels, is almost as big as its body

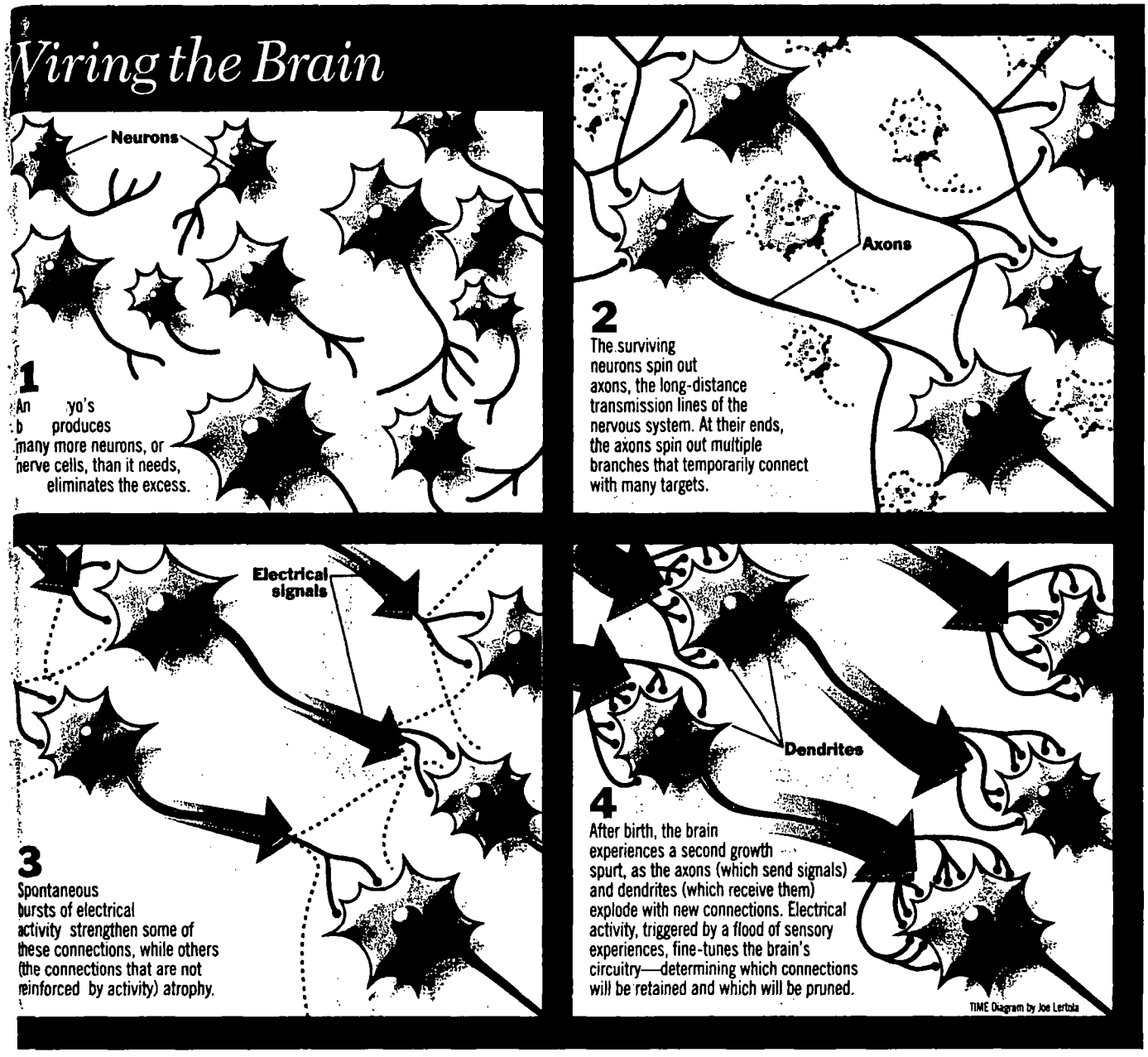
floor, actually change the shape of the brain, carving mental circuits into patterns that over time will enable the newborn infant to perceive a father's voice, a mother's touch, a shiny mobile twirling over the crib.

Of all the discoveries that have poured out of neuroscience labs in recent years, the finding that the electrical activity of brain cells changes the physical structure of the brain is perhaps the most breathtaking. For the rhythmic firing of neurons is no longer assumed to be a by-product of building the brain but essential to the process, and it begins, scientists have established, well before birth. A brain is not a computer. Nature does not cobble it together, then turn it on. No, the brain begins working long before it is finished. And the same processes that wire the brain before birth, neuroscientists are finding, also drive the explosion of learning that occurs immediately afterward.

At birth a baby's brain contains 100 billion neurons, roughly as many nerve cells as there are stars in the Milky Way. Also in place are a trillion glial cells, named after the Greek word for glue, which form a kind of honeycomb that protects and nourishes the neurons. But while the brain contains virtually all the nerve cells it will ever have, the pattern of wiring between them has yet to stabilize. Up to this point, says Shatz, "what the brain has done is lay out circuits that are its best guess about what's required for vision, for language, for whatever." And now it is up to neural activity—no longer spontaneous, but driven by a flood of sensory experiences—to take this rough blueprint and progressively refine it.

During the first years of life, the brain undergoes a series of extraordinary changes. Starting shortly after birth, a baby's brain, in a display of biological exuberance, produces trillions more connections between neurons than it can possibly use. Then, through a process that resembles Darwinian competition, the brain eliminates connections, or synapses, that are seldom or never used. The excess synapses in a child's brain undergo a draconian pruning, starting around the age of 10 or earlier, leaving behind a mind whose patterns of emotion and thought are, for better or worse, unique.

Wiring the Brain



Deprived of a stimulating environment, a child's brain suffers. Researchers at Baylor College of Medicine, for example, have found that children who don't play much or are rarely touched develop brains 20% to 30% smaller than normal for their age. Laboratory animals provide another provocative parallel. Not only do young rats reared in toy-strewn cages exhibit more complex behavior than rats confined to sterile, uninteresting boxes, researchers at the University of Illinois at Urbana-Champaign have found, but the brains of these rats contain as many as 25% more synapses per neuron. Rich experiences, in other words, really do produce rich brains.

The new insights into brain development are more than just interesting science. They have profound implications for parents and policymakers. In an age when mothers and fathers are increasingly pressed for time—and may already be feeling guilty about how many hours they spend away from their children—the results coming out of the labs are likely to increase concerns about leaving very young children in the care of others. For the data underscore the importance of hands-on parenting, of finding the time to cuddle a baby, talk with a toddler and provide infants with stimulating experiences.

The new insights have begun to infuse new passion into the political debate over early education and day care. There is an urgent need, say child-development experts, for preschool programs designed to boost the brain power of youngsters born into impoverished rural and inner-city households. Without such programs, they warn, the current drive to curtail welfare costs by pushing mothers with infants and toddlers into the work force may well backfire. "There is a time scale to brain development, and the most important year is the first," notes Frank Newman, president of the Education Commission of the States. By the age of three, a child who is neglected or abused bears marks that, if not indelible, are exceedingly difficult to erase.

But the new research offers hope as well. Scientists have found that the brain during the first years of life is so malleable that very young children who suffer strokes or injuries that wipe out an entire hemi-

sphere can still mature into highly functional adults. Moreover, it is becoming increasingly clear that well-designed preschool programs can help many children overcome glaring deficits in their home environment. With appropriate therapy, say researchers, even serious disorders like dyslexia may be treatable. While inherited problems may place certain children at greater risk than others, says Dr. Harry Chugani, a pediatric neurologist at Wayne State University in Detroit, that is no excuse for ignoring the environment's power to remodel the brain. "We may not do much to change what happens before birth, but we can change what happens after a baby is born," he observes.

Strong evidence that activity changes the brain began accumulating in the 1970s. But only recently have researchers had tools powerful enough to reveal the precise mechanisms by which those changes are brought about. Neural activity triggers a biochemical cascade that reaches all the way to the nucleus of cells and the coils of DNA that encode specific genes. In fact, two of the genes affected by neural activity in embryonic fruit flies, neurobiologist Corey Goodman and his colleagues at Berkeley reported late last year, are identical to those that other studies have linked to learning and memory. How thrilling, exclaims Goodman, how intellectually satisfying that the snippets of DNA that embryos use to build their brains are the very same ones that will later allow adult organisms to process and store new information.

As researchers explore the once hidden links between brain activity and brain structure, they are beginning to construct a sturdy bridge over the chasm that previously separated genes from the environment. Experts now agree that a baby does not come into the world as a genetically preprogrammed automaton or a blank slate at the mercy of the environment, but arrives as something much more interesting. For this reason the debate that engaged countless generations of philosophers—whether nature or nurture calls the shots—no longer interests most scientists. They are much too busy chronicling the myriad ways in which genes and the environment interact. "It's not a competition," says Dr. Stanley Greenspan, a psychiatrist at George Washington University. "It's a dance."

THE IMPORTANCE OF GENES

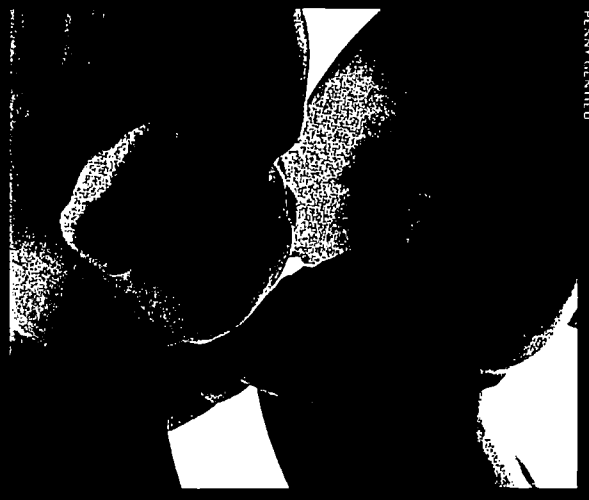
THAT DANCE BEGINS AT AROUND THE THIRD week of gestation, when a thin layer of cells in the developing embryo performs an origami-like trick, folding inward to give rise to a fluid-filled cylinder known as the neural tube. As cells in the neural tube proliferate at the astonishing rate of 250,000 a minute, the brain and spinal cord assemble themselves in a series of tightly choreographed steps. Nature is the dominant partner during this phase of development, but nurture plays a vital supportive role. Changes in the environment of the womb—whether caused by maternal malnutrition, drug abuse or a viral infection—can wreck the clockwork precision of the neural assembly line. Some forms of epilepsy, mental retardation, autism and schizophrenia appear to be the results of developmental processes gone awry.

But what awes scientists who study the brain, what still stuns them, is not that things occasionally go wrong in the developing brain but that so much of the time they go right. This is all the more remarkable, says Berkeley's Shatz, as the central nervous system of an embryo is not a miniature of the adult system but more like a tadpole that gives rise to a frog. Among other things, the cells produced in the neural tube must migrate to distant locations and accurately lay down the connections that link one part of the brain to another. In addition, the embryonic brain must construct a variety of temporary structures, including the neural tube, that will, like a tadpole's tail, eventually disappear.

What biochemical magic underlies this incredible metamorphosis? The instructions programmed into the genes, of course. Scientists have recently discovered, for instance, that a gene nicknamed "sonic hedgehog" (after the popular video game Sonic the Hedgehog) determines the fate of neurons in the spinal cord and the brain. Like a strong scent carried by the wind, the protein encoded by the hedgehog gene (so called because in its absence, fruit-fly embryos sprout a coat of prickles) diffuses outward from the cells that produce it, becoming fainter and fainter. Columbia University neurobiologist Thomas Jessell has found that it takes middling concentrations of this potent morphing factor to produce a motor neuron and lower concentrations to make an interneuron (a cell that relays signals to other neurons, instead of to muscle fibers, as motor neurons do).

Scientists are also beginning to identify some of the genes that guide neurons in their long migrations. Consider the problem faced by neurons destined to become part of the cerebral cortex. Because they

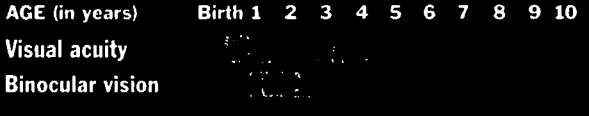
Wiring Vision



WHAT'S GOING ON Babies can see at birth, but not in fine-grained detail. They have not yet acquired the knack of focusing both eyes on a single object or developed more sophisticated visual skills like depth perception. They also lack hand-eye coordination.

WHAT PARENTS CAN DO There is no need to buy high-contrast black-and-white toys to stimulate vision. But regular eye exams, starting as early as two weeks of age, can detect problems that, if left uncorrected, can cause a weak or unused eye to lose its functional connections to the brain.

WINDOW OF LEARNING Unless it is exercised early on, the visual system will not develop.



arise relatively late in the development of the mammalian brain, billions of these cells must push and shove their way through dense colonies established by earlier migrants. "It's as if the entire population of the East Coast decided to move en masse to the West Coast," marvels Yale University neuroscientist Dr. Pasko Rakic, and marched through Cleveland, Chicago and Denver to get there.

But of all the problems the growing nervous system must solve, the most daunting is posed by the wiring itself. After birth, when the number of connections explodes, each of the brain's billions of neurons will forge links to thousands of others. First they must spin out a web of wirelike fibers known as axons (which transmit signals) and dendrites (which receive them). The objective is to form a synapse, the gaplike structure over which the axon of one neuron beams a signal to the dendrites of another. Before this can happen, axons and dendrites must almost touch. And while the short, bushy dendrites don't have to travel very far, axons—the heavy-duty cables of the nervous system—must traverse distances that are the microscopic equivalent of miles.

What guides an axon on its incredible voyage is a "growth cone," a creepy, crawly sprout that looks something like an amoeba. Scientists have known about growth cones since the turn of the century. What they didn't know until recently was that growth cones come equipped with the molecular equivalent of sonar and radar. Just as instruments in a submarine or airplane scan the environment for signals, so molecules arrayed on the surface of growth cones search their surroundings for the presence of certain proteins. Some of these proteins, it turns out, are attractants that pull the growth cones toward them, while others are repellents that push them away.

THE FIRST STIRRINGS

UP TO THIS POINT, GENES HAVE CONtrolled the unfolding of the brain. As soon as axons make their first connections, however, the nerves begin to fire, and what they do starts to matter more and more. In essence, say scientists, the developing nervous system has strung the equivalent of telephone trunk lines between the right neighborhoods in the right cities. Now it has to sort out which wires belong to which house, a problem that cannot be solved by genes alone for reasons that boil down to simple arithmetic. Eventually, Berkeley's Goodman estimates, a human brain must forge quadrillions of connections. But there are only 100,000 genes in human DNA. Even though half these genes—some 50,000—appear to be dedicated to constructing and maintaining the nervous system, he observes, that's not enough to specify more than a tiny fraction of the connections required by a fully functioning brain.

In adult mammals, for example, the axons that connect the brain's visual system arrange themselves in striking layers and columns that reflect the division between the left eye and the right. But these axons start out as scrambled as a bowl of spaghetti, according to Michael Stryker, chairman of the physiology department at the University of California at San Francisco. What sorts out the mess, scientists have established, is neural activity. In a series of experiments viewed as classics by scientists in the field, Berkeley's Shatz chemically blocked neural activity in embryonic cats. The result? The axons that connect neurons in the retina of the eye to the brain never formed the left eye–right eye geometry needed to support vision.

But no recent finding has intrigued researchers more than the results reported in October by Corey Goodman and his Berkeley colleagues. In studying a deceptively simple problem—how axons from motor neurons in the fly's central nerve cord establish connections with muscle cells in its limbs—the Berkeley researchers made an unexpected discovery. They knew there was a gene that keeps bundles of axons together as they race toward their muscle-cell targets. What they discovered was that the electrical activity produced by neurons inhibited this gene, dramatically increasing the number of connections the axons made. Even more intriguing, the signals amplified the activity of a second gene—a gene called CREB.

The discovery of the CREB amplifier, more than any other, links the developmental processes that occur before birth to those that continue long after. For the twin processes of memory and learning in adult animals, Columbia University neurophysiologist Eric Kandel has shown, rely on the CREB molecule. When Kandel blocked the activity of CREB in giant snails, their brains changed in ways that suggested that they could still learn but could remember what they learned for only a short period of time. Without CREB, it seems, snails—and by extension, more developed animals like hu-

Wiring Feelings

WHAT'S GOING ON Among the first circuits the brain constructs are those that govern the emotions. Beginning around two months of age, the distress and contentment experienced by newborns start to evolve into more complex feelings: joy and sadness, envy and empathy, pride and shame.

WHAT PARENTS CAN DO Loving care provides a baby's brain with the right kind of emotional stimulation. Neglecting a baby can produce brain-wave patterns that dampen happy feelings. Abuse can produce heightened anxiety and abnormal stress responses.

WINDOW OF LEARNING Emotions develop in layers, each more complex than the last.

mans—can form no long-term memories. And without long-term memories, it is hard to imagine that infant brains could ever master more than rudimentary skills. "Nurture is important," says Kandel. "But nurture works through nature."

EXPERIENCE KICKS IN

WHEN A BABY IS BORN, IT CAN SEE and hear and smell and respond to touch, but only dimly. The brain stem, a primitive region that controls vital functions like heartbeat and breathing, has completed its wiring. Elsewhere the connections between neurons are wispy and weak. But over the first few months of life, the brain's higher centers explode with new synapses. And as dendrites and axons swell with buds and branches like trees in spring, metabolism soars. By the age of two, a child's brain contains twice as many synapses and consumes twice as much energy as the brain of a normal adult.

University of Chicago pediatric neurologist Dr. Peter Huttenlocher has chronicled this extraordinary epoch in brain development by autopsying the brains of infants and young children who have died unexpectedly. The number of synapses in one layer of the visual cortex, Huttenlocher reports, rises from around 2,500 per neuron at birth to as many as 18,000 about six months later. Other regions of the cortex score similarly spectacular increases but on slightly different schedules. And while these microscopic connections between nerve fibers continue to form throughout life, they reach their highest average densities (15,000 synapses per neuron) at around the age of two and remain at that level until the age of 10 or 11.

This profusion of connections lends the growing brain exceptional flexibility and resilience. Consider the case of 13-year-old Brandi Binder, who developed such severe epilepsy that surgeons at UCLA had to remove the entire right side of her cortex when she was six. Binder lost virtually all the control she had established over muscles on the left side of her body, the side controlled by the right side of the brain. Yet today, after years of therapy ranging from leg lifts to math and music drills, Binder is an A student at the Holmes Middle School in Colorado Springs, Colorado. She loves music, math and art—skills usually associated with the right half of the brain. And while Binder's recuperation is not 100%—for example, she has never regained the use of her left arm—it comes close. Says UCLA pediatric neurologist Dr. Donald Shields: "If there's a way to compensate, the developing brain will find it."

What wires a child's brain, say neuroscientists—or rewires it after physical trauma—is repeated experience. Each time a baby tries to touch a tantalizing object or gazes intently at a face or listens to a lullaby, tiny bursts of electricity shoot through the brain, knitting neurons into circuits as well defined as those etched onto silicon chips. The results are those behavioral mileposts that never cease to delight and awe parents. Around the age of two months, for example, the motor-control centers of the brain develop to the point that infants can suddenly reach out and grab a nearby object. Around the age of four months, the cortex begins to refine the connections needed for depth perception and binocular vision. And around the age of 12 months, the speech centers of the brain are poised to produce what is perhaps the most magical moment of childhood: the first word that marks the flowering of language.

When the brain does not receive the right information—or shuts it out—the result can be devastating. Some children who display early signs of autism, for example, retreat from the world because they are hypersensitive to sensory stimulation, others because their senses are underactive and provide them with too little information. To be effective, then, says George Washington University's Greenspan, treatment must target the underlying condition, protecting some children from disorienting noises and lights, providing others with attention-grabbing stimulation. But when parents and therapists collaborate in an intensive effort to reach these abnormal brains, writes Greenspan in a new book, *The Growth of the Mind* (Addison-Wesley, 1997), three-year-olds who begin the descent into the autistic's limited universe can sometimes be snatched back.

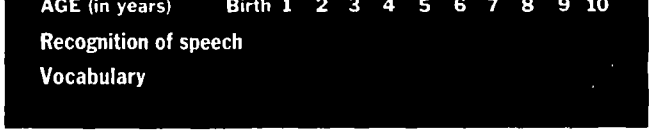
Indeed, parents are the brain's first and most important teachers. Among other things, they appear to help babies learn by adopting the rhythmic, high-pitched speaking style known as Parentese. When speaking to babies, Stanford University psychologist Anne Fernald has found, mothers and fathers from many cultures change their speech patterns in the same peculiar ways. "They put their faces very close to the child," she reports. "They use shorter utterances, and they speak in an unusually melodious fashion." The heart rate of infants increases while listening to Parentese, even Parentese delivered in a

Wiring Language

WHAT'S GOING ON Even before birth, an infant is tuning into the melody of its mother's voice. Over the next six years, its brain will set up the circuitry needed to decipher—and reproduce—the lyrics. A six-month-old can recognize the vowel sounds that are the basic building blocks of speech.

WHAT PARENTS CAN DO Talking to a baby a lot, researchers have found, significantly speeds up the process of learning new words. The high-pitched, singsong speech style known as Parentese helps babies connect objects with words.

WINDOW OF LEARNING Language skills are sharpest early on but grow throughout life.



foreign language. Moreover, Fernald says, Parentese appears to hasten the process of connecting words to the objects they denote. Twelve-month-olds, directed to "look at the ball" in Parentese, direct their eyes to the correct picture more frequently than when the instruction is delivered in normal English.

In some ways the exaggerated, vowel-rich sounds of Parentese appear to resemble the choice morsels fed to hatchlings by adult birds. The University of Washington's Patricia Kuhl and her colleagues have conditioned dozens of newborns to turn their heads when they detect the *ee* sound emitted by American parents, vs. the *eu* favored by doting Swedes. Very young babies, says Kuhl, invariably perceive slight variations in pronunciation as totally different sounds. But by the age of six months, American babies no longer react when they hear variants of *ee*, and Swedish babies have become impervious to differences in *eu*. "It's as though their brains have formed little magnets," says Kuhl, "and all the sounds in the vicinity are swept in."

TUNED TO DANGER

EVEN MORE FUNDAMENTAL, SAYS Dr. Bruce Perry of Baylor College of Medicine in Houston, is the role parents play in setting up the neural circuitry that helps children regulate their responses to stress. Children who are physically abused early in life, he observes, develop brains that are exquisitely tuned to danger. At the slightest threat, their hearts race, their stress hormones surge and their brains anxiously track the nonverbal cues that might signal the next attack. Because the brain develops in sequence, with more primitive structures stabilizing their connections first, early abuse is particularly damaging. Says Perry: "Experience is the chief architect of the brain." And because these early experiences of stress form a kind of template around which later brain development is organized, the changes they create are all the more pervasive.

Emotional deprivation early in life has a similar effect. For six years University of Washington psychologist Geraldine Dawson and her colleagues have monitored the brain-wave patterns of children born to mothers who were diagnosed as suffering from depression. As infants, these children showed markedly reduced activity in the left frontal lobe, an area of the brain that serves as a center for joy and other lighthearted emotions. Even more telling, the patterns of brain activity displayed by these children closely tracked the ups and downs of their mother's depression. At the age of three, children whose mothers were more severely depressed or whose depression lasted longer continued to show abnormally low readings.

Strikingly, not all the children born to depressed mothers develop these aberrant brain-wave patterns, Dawson has found. What accounts for the difference appears to be the emotional tone of the exchanges between mother and child. By scrutinizing hours of videotape that show depressed mothers interacting with their babies, Dawson has attempted to identify the links between maternal behavior and children's brains. She found that mothers who were disengaged, irritable or impatient had babies with sad brains. But depressed mothers who managed to rise above their melancholy, lavishing their babies with attention and indulging in playful games, had children with brain activity of a considerably more cheerful cast.

When is it too late to repair the damage wrought by physical and emotional abuse or neglect? For a time, at least, a child's brain is extremely forgiving. If a mother snaps out of her depression before her child is a year old, Dawson has found, brain activity in the left frontal lobe quickly picks up. However, the ability to rebound declines markedly as a child grows older. Many scientists believe that in the first few years of childhood there are a number of critical or sensitive periods, or "windows," when the brain demands certain types of input in order to create or stabilize certain long-lasting structures.

For example, children who are born with a cataract will become permanently blind in that eye if the clouded lens is not promptly removed. Why? The brain's visual centers require sensory stimulus—in this case the stimulus provided by light hitting the retina of the eye—to maintain their still tentative connections. More controversially, many linguists believe that language skills unfold according to a strict, biologically defined timetable. Children, in their view, resemble certain species of birds that cannot master their song unless they hear it sung at an early age. In zebra finches the window for acquiring the appropriate song opens 25 to 30 days after hatching and shuts some 50 days later.

WINDOWS OF OPPORTUNITY

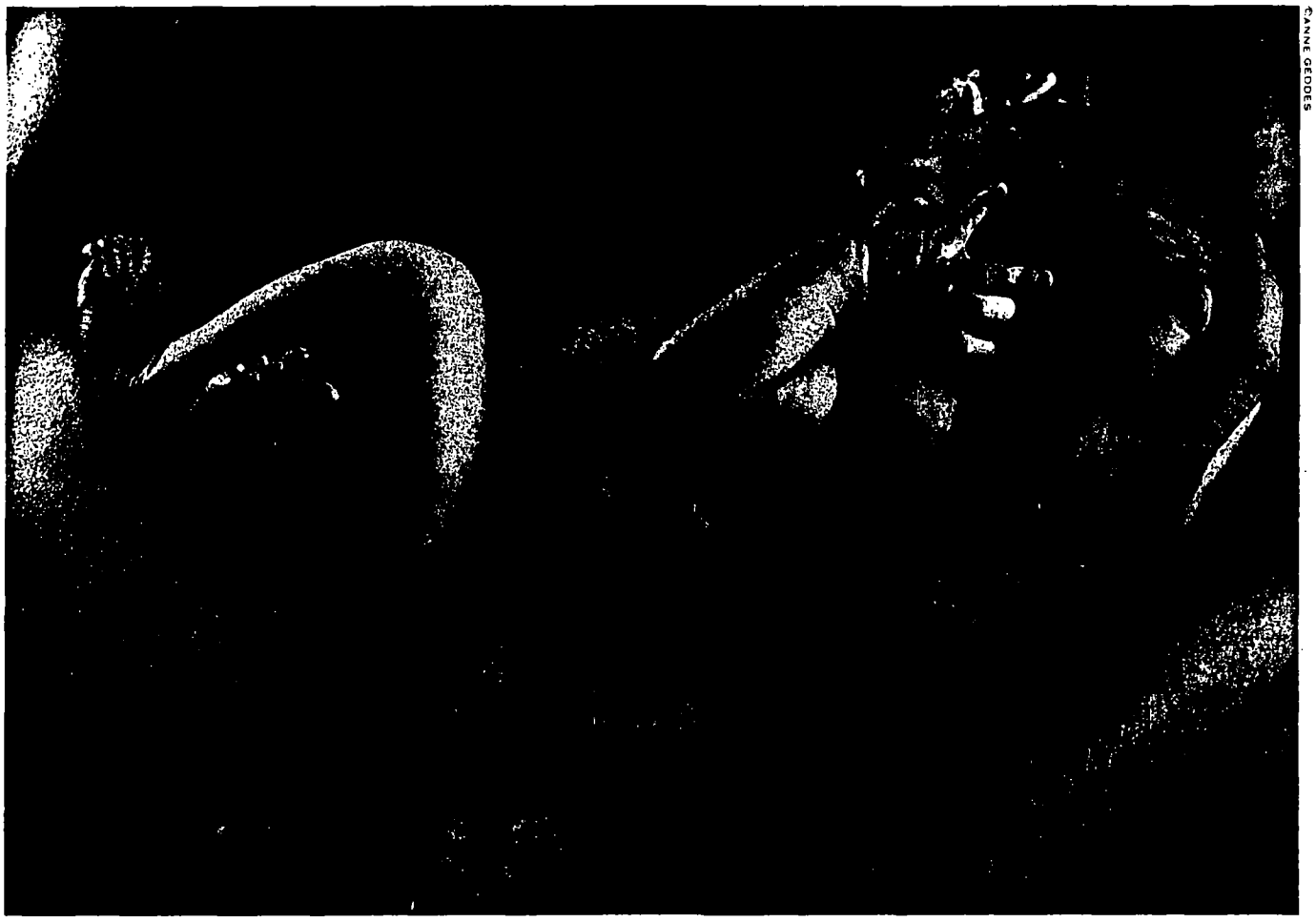
WITH A FEW EXCEPTIONS, THE WINDOWS OF opportunity in the human brain do not close quite so abruptly. There appears to be a series of windows for developing lan-

Wiring Movement

WHAT'S GOING ON At birth babies can move their limbs, but in a jerky, uncontrolled fashion. Over the next four years, the brain progressively refines the circuits for reaching, grabbing, sitting, crawling, walking and running.

WHAT PARENTS CAN DO Give babies as much freedom to explore as safety permits. Just reaching for an object helps the brain develop hand-eye coordination. As soon as children are ready for them, activities like drawing and playing a violin or piano encourage the development of fine motor skills.

WINDOW OF LEARNING Motor-skill development moves from gross to increasingly fine.



guage. The window for acquiring syntax may close as early as five or six years of age, while the window for adding new words may never close. The ability to learn a second language is highest between birth and the age of six, then undergoes a steady and inexorable decline. Many adults still manage to learn new languages, but usually only after great struggle.

The brain's greatest growth spurt, neuroscientists have now confirmed, draws to a close around the age of 10, when the balance between synapse creation and atrophy abruptly shifts. Over the next several years, the brain will ruthlessly destroy its weakest synapses, preserving only those that have been magically transformed by experience. This magic, once again, seems to be encoded in the genes. The ephemeral bursts of electricity that travel through the brain, creating everything from visual images and pleasurable sensations to dark dreams and wild thoughts, ensure the survival of synapses by stimulating genes that promote the release of powerful growth factors and suppressing genes that encode for synapse-destroying enzymes.

By the end of adolescence, around the age of 18, the brain has declined in plasticity but increased in power. Talents and latent tendencies that have been nurtured are ready to blossom. The experiences that drive neural activity, says Yale's Rakic, are like a sculptor's chisel or a dressmaker's shears, conjuring up form from a lump of stone or a length of cloth. The presence of extra material expands the range of possibilities, but cutting away the extraneous is what makes art. "It is the overproduction of synaptic connections followed by their loss that leads to patterns in the brain," says neuroscientist William Greenough of the University of Illinois at Urbana-Champaign. Potential for greatness may be encoded in the genes, but whether that potential is realized as a gift for mathematics, say, or a brilliant criminal mind depends on patterns etched by experience in those critical early years.

Psychiatrists and educators have long recognized the value of early experience. But their observations have until now been largely anecdotal. What's so exciting, says Matthew Melmed, executive director of Zero to Three, a nonprofit organization devoted to highlighting the importance of the first three years of life, is that modern neuroscience is providing the hard, quantifiable evidence that was missing earlier. "Because you can see the results under a microscope or in a PET scan," he observes, "it's become that much more convincing."

What lessons can be drawn from the new findings? Among other things, it is clear that foreign languages should be taught in elementary school, if not before. That remedial education may be more effective at the age of three or four than at nine or 10. That good, affordable day care is not a luxury or a fringe benefit for welfare mothers and working parents but essential brain food for the next generation. For while new synapses continue to form throughout life, and even adults continually refurbish their minds through reading and learning, never again will the brain be able to master new skills so readily or rebound from setbacks so easily.

Rat-a-tat-tat. Rat-a-tat-tat. Rat-a-tat-tat. Just last week, in the U.S. alone, some 77,000 newborns began the miraculous process of wiring their brains for a lifetime of learning. If parents and policymakers don't pay attention to the conditions under which this delicate process takes place, we will all suffer the consequences—starting around the year 2010. ■

THE DAY-CARE

By JAMES COLLINS

ENVIRONMENT MATTERS. FOR ANYone wondering how the latest brain research applies to the care of infants and toddlers, that is the crucial finding. Yes, proper brain development is a matter of genetics and nutrition and whether a mother-to-be drinks or smokes, but it also depends on the stimuli, as the scientists call them, that a baby receives. It depends on what the baby sees, hears and touches and on the emotions he or she repeatedly experiences. But if environment matters, we are faced with a question: At a time when children suffer from perhaps the gravest social problems of any group in the U.S., how do we ensure that they grow up in the best environment possible?

In many ways, children are better off today than they were in previous decades. They are healthier, their families have a higher income, the level of their mother's education (the most important determinant of a child's intelligence) has risen. But 1 out of every 10 children three years old and younger lives in "extreme poverty"—at or below 50% of the federal poverty level. And the well-being of many others is threatened by such social changes as the rise of single-parent households, the uneven quality of day care, the decline of communities and, some would argue, the push to reform the welfare system.

Social policy cannot ameliorate all these conditions. A change in attitude toward parenting and marriage would do children far more good than any government program. Over the past few years, however, there has been a movement in Washington and the state capitals to address the problems of children, from newborn to the age of three. Now neuroscientists, by confirming much of what social scientists had already surmised about early development, are giving that movement added momentum.

The recent concern about infants and toddlers has been inspired in part by *Starting Points*, a landmark report published by the Carnegie Corporation in 1994, which identified a "quiet crisis" in the lives of the youngest children. Hillary Clinton has begun to speak out on the importance of a child's earliest years, and several Governors have forcefully taken up the issue. The size of the programs in place is quite modest. But to their advocates they hold out promise not only

DILEMMA

Too many children today live in conditions that threaten their brain development. What can we do?

of helping children fulfill their potential but also of saving society the costs incurred when intellectually and socially impaired children grow up to be intellectually and socially impaired adults.

Government policy in any number of areas—health care, taxes, the economy, crime—touches children. But the initiative that will have the most particular and powerful effect on them is welfare reform. If, as some predict, the incomes of poor mothers are drastically reduced as a result of the new system, children will be harmed.

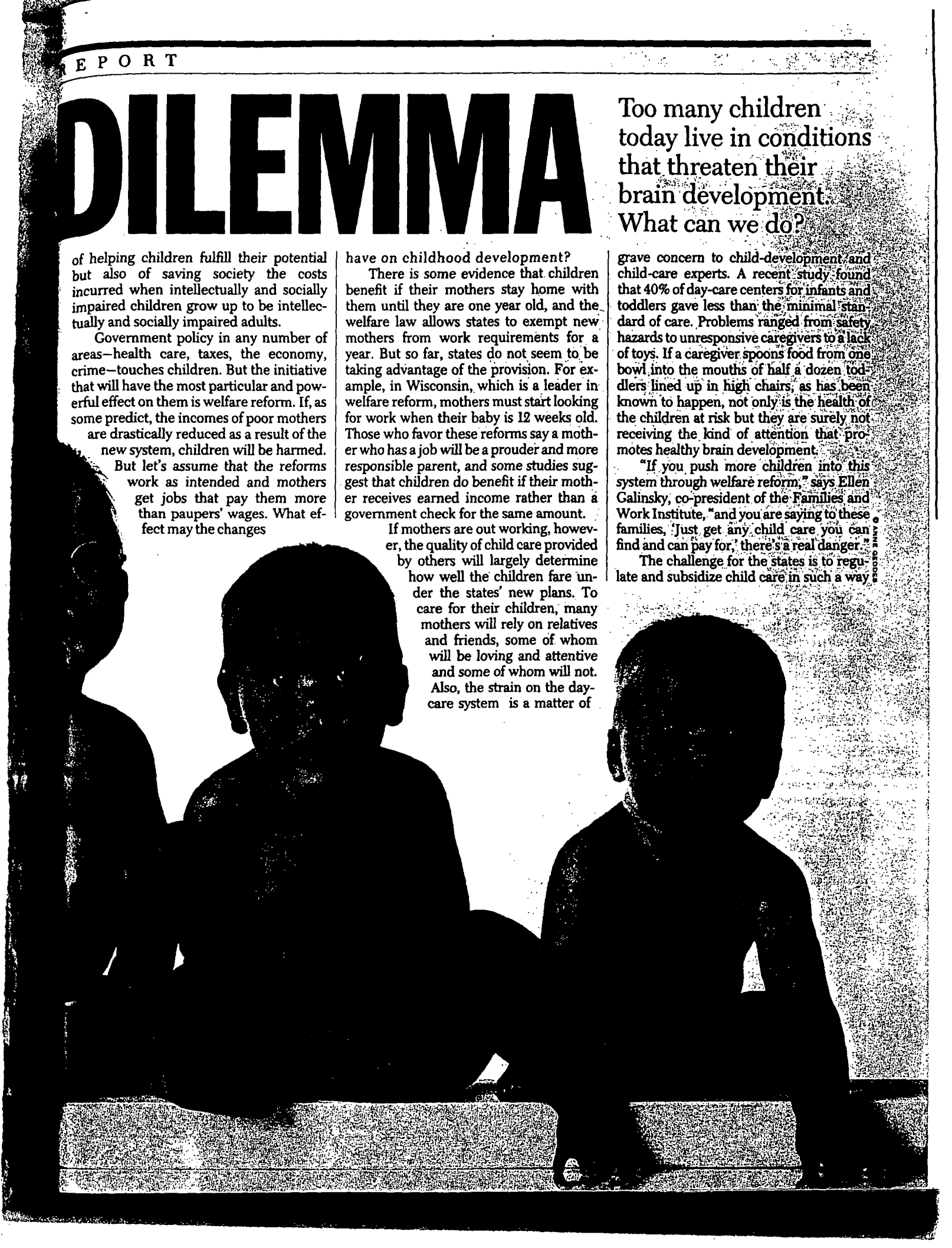
But let's assume that the reforms work as intended and mothers get jobs that pay them more than paupers' wages. What effect may the changes have on childhood development?

There is some evidence that children benefit if their mothers stay home with them until they are one year old, and the welfare law allows states to exempt new mothers from work requirements for a year. But so far, states do not seem to be taking advantage of the provision. For example, in Wisconsin, which is a leader in welfare reform, mothers must start looking for work when their baby is 12 weeks old. Those who favor these reforms say a mother who has a job will be a prouder and more responsible parent, and some studies suggest that children do benefit if their mother receives earned income rather than a government check for the same amount.

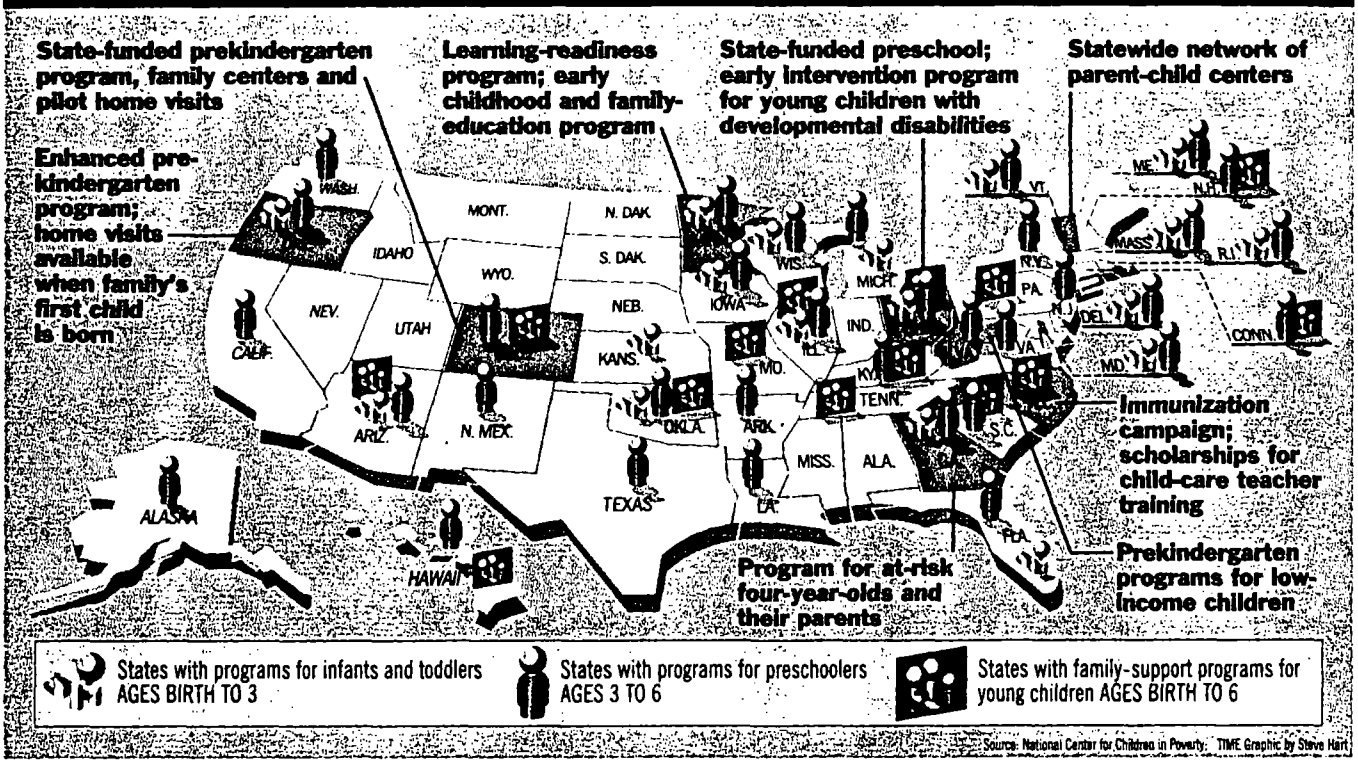
If mothers are out working, however, the quality of child care provided by others will largely determine how well the children fare under the states' new plans. To care for their children, many mothers will rely on relatives and friends, some of whom will be loving and attentive and some of whom will not. Also, the strain on the day-care system is a matter of grave concern to child-development and child-care experts. A recent study found that 40% of day-care centers for infants and toddlers gave less than the minimal standard of care. Problems ranged from safety hazards to unresponsive caregivers to a lack of toys. If a caregiver spoons food from one bowl into the mouths of half a dozen toddlers lined up in high chairs, as has been known to happen, not only is the health of the children at risk but they are surely not receiving the kind of attention that promotes healthy brain development.

"If you push more children into this system through welfare reform," says Ellen Galinsky, co-president of the Families and Work Institute, "and you are saying to these families, 'Just get any child care you can find and can pay for,' there's a real danger."

The challenge for the states is to regulate and subsidize child care in such a way



What States Are Doing



Source: National Center for Children in Poverty. TIME Graphic by Steve Hart

as to increase the likelihood of good outcomes for children. This is true regardless of welfare reform, of course. Bad day-care can harm the development of any child. Research has shown that children benefit when caregivers are trained and the ratio of staff to children is high. Several states license centers accordingly, requiring a minimum amount of training and setting ratios for different age groups. Welfare mothers themselves are not necessarily the best caregivers, and it is possible that in some instances welfare reform will actually improve the care of children. But high-quality care is expensive, and states do not have adequate budgets to subsidize it.

The Federal Government and the states do have programs specifically aimed at helping the development of infants and toddlers, although as social policy they are nowhere near as sweeping as an overhaul of welfare. The most notable federal initiative is Early Head Start, which was created in 1994 when Congress reauthorized funding for Head Start, the 32-year-old program that brings three-, four- and five- year-olds into classroom settings in part to prepare them for school. Mary Jo Bane was working at the time at the Department of Health and Human Services (she quit over welfare reform), and she led a task force charged with finding ways to improve Head Start. Child-development experts, she says, "pointed the group toward the importance of interventions earlier than age four."

In 1996, the budget for Early Head Start was $146 million, and HHS awarded grants to 143 sites. The money is used to provide a variety of services to poor families with children under the age of four and to poor pregnant women. How the funds are spent is determined to some extent by the communities that receive them. Some communities are experimenting with family interventions that include grandparents; others are trying to address the special health needs of newborns or to provide extra help to teen parents with a history of drug abuse.

SMART START, HEALTHY START

NORTH CAROLINA HAS INSTITUTED A FLEXIble program called Smart Start. Under it, parents, teachers, doctors and nurses, child-care providers, ministers and businesspeople form partnerships at the county level that set goals for the education and health care of children under six. These partnerships then administer private and public funds as they see fit. In one county, for example, administrators chose to give subsidies to new parents so that mothers could stay home from work during a baby's first year. More than half of North Carolina's 100 counties are participating in the program, at a cost to the state of $68 million.

Governor James Hunt hopes that by adding hard science to his arguments, he will strengthen his position when battling for increases in Smart Start funding. "This is revolutionary information," he says of studies demonstrating the sensitivity of babies' brains in the first years of life. "Now that we can measure it and prove it, and if it can be made known widely so people understand this, then they'll understand why their schools aren't going to work for them, their technical training isn't going to work, other things we do later on aren't going to work fully unless we do this part right and do this at the appropriate time."

Some states have found that a very simple but powerful way to help parents is simply to coordinate the various services that they already offer. In West Virginia, for example, single sites that provide more than a dozen services have been established in seven communities. "Parents typically get a runaround and may only get a long list of phone numbers," says Kimberly Veraas, chairwoman of the state's Early Childhood Implementation Commission. "If they're really motivated, they can get information. But now we're rolling out the red carpet to parents. They only have to tell their story once."

As developmental experts often point out, child rearing is not an innate skill, and several states are trying to help educate parents about parenting. Home visits by

social workers or nurses are among the most promising methods. In Oregon such visits occur under a program called Healthy Start. Sandra Daus, 22, a single mother of an 18-month-old girl, recalls the help she received from Mellissa Magill. "She encouraged me to read books, a lot of books," says Daus. "I thought when Sydney got older, maybe two or three, we'd start reading. Mellissa said no, start reading to her now. Sydney was a month old."

In Vermont someone from the state's Success by Six program first visits a home within two weeks of a baby's birth. "That gets us in the door at age zero instead of age five, so we can assess what families need," Governor Howard Dean points out. Visits may continue for up to three years. "It is so inexpensive," says Dean, "to take care of children relative to the other things we do, such as build jails and put up expensive social-service networks for runaway youth."

With the new scientific evidence to bolster it, the logic for spending money on early-childhood development programs may seem incontrovertible. But not everyone is convinced. The question of what approaches have worked and will work has not been resolved. Research supports the long-term benefits of older programs that are used as models today, but those studies are criticized because they look at very small samples of children who were given special attention and care.

"We have seen over and over and over that even if you can produce good results with small programs, when you expand to a national level, the effect often disappears," says Ronald Haskins, a top Republican staff member of the House Ways and Means Committee. "That is the case with Head Start. We still do not have evidence that Head Start produces any long-term effects."

Social science, however, is an imperfect discipline. Referring to programs for young children, Isabel Sawhill, a scholar at the Urban Institute and former official in the Clinton Administration, has written, "The evidence is always mixed. We simply do not know whether they work. In these cases, one must weigh the risk of doing something and having it not work against the risk of doing nothing and missing an opportunity to improve lives. It can be just as costly to not fund a potentially successful program as it is to fund a potentially unsuccessful one."

Right now, the total public expenditure on early-childhood development is tiny. Given the potential rewards, how risky is a bigger investment? ***—Reported by Ann Blackman/Washington, Wendy Cole/Chicago, Rita Healy/Denver, Melissa Ludtke/Cambridge and Lisa H. Towle/Raleigh***

ROBERT DEMICHIELL FOR TIME

HOLLYWOOD GOES GAGA

Whoopi, Robin, Rob and friends have found a new cause

CELEBRITIES WHO PUBLICLY EMBRACE worthy causes sometimes seem to be auditioning less for *Sense and Sensibility* than for *Clueless*. Stars have dangled from bridges to protest logging practices, hawked clothes made in sweatshops while promoting moral values and slugged pesky photographers even as they were begging for kindness to animals. A recent surge of show-biz interest in children, however, seems to be as well aimed as it is high profile. More than half a dozen organizations founded or funded by Hollywood celebrities are zeroing in on kids' issues. And early childhood development is one of their top concerns.

In April, ABC-TV will air a prime-time special on brain development, directed by Rob Reiner and featuring such A-list stars as Tom Hanks and Robin Williams. It's the opening shot of an elaborate multimedia blitz that is coordinated by Families and Work Institute, based in New York City, and includes public-service announcements, magazine specials, home videos, online sites and CD-ROMS. "I couldn't create a big, federally funded program," says Reiner. "But I certainly can put on a show to raise awareness about how the first three years critically impact the way a child later deals with society."

Reiner says he became interested in baby brain activity three years ago during his own analysis. Now he is taking his case directly to the top. He has been urging President Clinton to host a Washington summit on the subject, and last month sat beside Hillary Clinton at a White House arts-award dinner. The next day she gave a speech that included a long section on early-childhood learning. "It's an important issue for the President to get on," says Reiner. "You talk about trying to fix the welfare situation. This is a way to do it."

Reiner is one of dozens of celebrities who have joined Hollywood's latest children's crusade. Whoopi Goldberg, Barbra Streisand, Whitney Houston and Henry Winkler have all donated their names, their time and even their money to various kids' causes. Not only did Steven Spielberg and his wife Kate Capshaw cofound the Children's Action Network, which makes educational films and sponsors immunization campaigns, but Spielberg also chairs the Starbright Foundation, an innovative charity group that deploys entertainment technologies to help ease the suffering of sick children.

Hollywood's interest in a cause often means Big Money. A benefit movie premiere can raise up to $350,000 in a single night. Still, as Starbright managing director Chris Garvey notes, "Our board members give more than their money and Rolodexes. They relish the hands-on experience of dealing with children in hospitals."

But not too hands on. Celebrity sightings at clinics and youth shelters are, for the most part, rare. "We try to provide children with a calm, soothing place, not chaotic, star-studded events," says Leslie Johnson of the Westside Children's Center in Culver City, California. "Besides, children under three have different ideas about celebrity. When Barney came to our Christmas party, Jim Carrey could have been standing there and no one would have noticed him." ***—By Jeffrey Ressner/Los Angeles***

Hillary Rodham Clinton

Comfort and Joy

The First Mom suggests reading as an easy way to help a baby's brain grow

THE NIGHT AFTER THE INAUGURAL, BILL AND I GATHERED with our family in the solarium on the third floor of the White House. After dinner our toddler nephews Tyler and Zachary climbed up on the couch with their Uncle Bill to hear him read a story. They accompanied him with words, sounds, pointed fingers and a few tussles over who would hold the book. As I watched them, I thought of all the times Bill and I used to take turns reading stories to Chelsea. Every night one of us (and occasionally both) would stretch out on her bed, hold her in our arms, and either read or make up new tales about imaginary characters who embarked on improbable but breathtaking adventures.

Bill and I did not know about brain cells or synapses or the newest discoveries in neuroscience. Reading to Chelsea became a daily ritual because it's what our own parents and grandparents had done with us, and because we wanted to spend quiet time with her every day. Bill's grandmother thought that reading to him would help him develop a strong vocabulary and the language skills he would need later on in school. My mother and father placed a similar premium on reading, and to this day I remember the feelings of security and comfort that I felt sitting in my grandfather's lap when he read stories to my brothers and me.

Mrs. Clinton with her daughter in the crucial first three years

Today, thanks to advances in brain research, we know that reading with a child has intellectual, emotional and physical benefits that can enhance the child's development. The intimacy of sharing books and stories strengthens the emotional bonds between a parent and child, helps a child learn words and concepts, and actually stimulates the growth of a baby's brain.

As I discussed in my book, *It Takes a Village*, scientists have discovered that children whose parents read and talk to them during the first three years of life create a stronger foundation for future reading success. In other words, what our parents and grandparents knew instinctively is now backed up by hard scientific evidence.

That's why doctors and nurses are starting to *prescribe* reading to babies along with regular checkups and vaccinations. Recently I went to Georgetown University's Medical Center with Maurice Sendak, the renowned children's author and illustrator. His book *Where the Wild Things Are* was one of Chelsea's—and Bill's—favorites. Mr. Sendak read the story to children, and I announced, along with representatives of the American Academy of Pediatrics, the American Booksellers Association and the American Library Association, a national campaign to put books in the hands of parents who bring their young children to the doctor, and to get doctors to prescribe daily reading. My husband and I will be discussing this and other activities to follow up on the latest findings about the brain at a White House conference in the spring.

It's important that we take to heart what the neuroscientists are telling us—without losing the heart of the reading experience. In today's high-tech world of E-mail and microchips, it is easy to forget the importance of human connections in our daily activities. Technology has brought many welcome conveniences to our lives. But it has the potential to create feelings of distance, detachment and isolation among us.

Reading to a child while touching, hugging and holding him or her can be a wonderful antidote to the impersonal tendencies of the information age—for both the adult and the child. While critical to building brains, reading is equally important to building trusting and close relationships. That's why many of us remember the warm embrace or the comfortable lap that cradled us when we read books as children. And that's why reading should not be viewed solely as an intellectual proposition, particularly in the era in which we now live.

If Americans take away only one lesson from these exciting scientific discoveries, I hope it's that reading to children is easy, affordable and feasible for parents no matter what their level of education or economic station in life. Children's books are available for free at public libraries in every community and can be found at reasonable prices in many bookstores. Doctors, librarians, teachers, book publishers, business leaders and the news media can help make books available to families and educate parents about the vital role that reading plays in our children's lives.

It isn't very often that we have before us such a simple, inexpensive and pleasurable way to improve our children's health and development and raise their prospects for a brighter future. Whether you lie down together on the rug, sit together in an old rocking chair or cuddle on your child's bed the way Bill and I used to with Chelsea, there is no better way to spend time than reading to your child.

And now we also know that there are few better ways to help your baby's brain grow. ■

Effects of Educational TV Viewing of Lower Income Preschoolers on Academic Skills, School Readiness, and School Adjustment One to Three Years Later

A Report to Children's Television Workshop

John C. Wright and Aletha C. Huston

Center for Research on the Influences of Television on Children

The University of Kansas

Lawrence, KS 66045

February, 1995

Effects of educational TV viewing of lower income preschoolers on academic skills, school readiness, and school adjustment one to three years later.

Executive Summary

Background and Purpose of Study

This report summarizes the key initial results from a four-year longitudinal study of low-income children's media use and its relationship to the subsequent development of their academic skills, school readiness, and school adjustment.

Method

More than 250 families with a preschool child participated in the study. Children were 2 or 4 years old at the beginning of the study, 5 or 7 at the end. All families lived in low-income census tracts, and 46% had received means-tested assistance in the past 3 years. About 40% were African American, 40% European American, and 20 % Hispanic.

Families were evaluated four times, each a year apart, in an office visit lasting about two hours, during which the parent was interviewed, and the child was tested on a variety of achievement tests and assessment situations.

A two-hour visit was made to the home of each family on four occasions, also a year apart, to assess supports for social, emotional, cognitive and educational development.

During the year separating each of these home and office assessments, periodic telephone interviews were conducted with the parents, yielding a detailed record accounting for how the child spent every minute of the preceding day.

In analyses of the relationship between television viewing and subsequent academic outcomes, statistical controls were applied for parent education, family income, preschool attendance, the child's first language, the supportiveness of the home environment, and the child's initial level of language skills at the outset of the study.

Key Findings

The children's viewing of educational children's programming accounted for just under two hours per week at ages two to four, and declined to about one hour per week by age six to seven. Almost 80 % of that viewing up to age five was accounted for by Sesame Street.

Non-educational cartoon viewing occupied 7-8 hours per week of these children's lives up to the time when they started kindergarten, then it declined.

Viewing of adult (general audience) programs was about 16 hours per week at age 2 (mostly because they were with parents who were watching). This viewing declined to 8 hours by age 5 or 6, then started to rise slowly at age 7, to about 9 hours per week.

Viewing of children's educational programs was **negatively** related to viewing of non-educational cartoons and adult entertainment programming. The relationship was small, but consistent.

Up to age five, there was a strong **positive** relationship of viewing educational children's programs in general, and Sesame Street in particular, to time spent reading or being read to and time spent in educational activities. It was still positive, but less so, at 6 and 7.

Viewing of non-educational cartoons and of adult entertainment programs was consistently **negatively** related to time spent reading, and also negatively, but less strongly, to time spent in educational activities.

For the younger children only, prior viewing of children's educational programs in general, and Sesame Street in particular, were consistent **positive** predictors of letter-word knowledge, math skills, vocabulary size, and school readiness on age-appropriate standardized achievement tests, even when statistical controls for children's background and initial levels of language skills were applied. About 25 minutes per day of viewing added a third of a standard deviation in test scores (about 5 points on a test with a range of scores from 70 to 130 points).

With the same controls in place, non-educational cartoon viewing and adult program viewing had consistently **negative**, but somewhat weaker effects on the same outcomes.

For six- and seven-year-olds, prior viewing of children's educational programs in general, and Sesame Street in particular, was a **positive** predictor of reading skill (paragraph comprehension) and also a positive predictor of teachers' judgments of overall school adjustment in first or second grade.

Conclusion

*Young disadvantaged children's viewing of Sesame Street and other educational children's programs appears to play a **positive** causal role in their development of readiness for school. That contribution occurs between two and five years of age, and is independent of the contributions of parents' education, quality of the home environment, and family income, all of which also make contributions to the same **positive** outcomes. By contrast, the viewing of non-educational cartoons and adult programming has **negative** effects on readiness for school. Among four- to seven-year-olds educational TV viewing **favorably** affects reading and school adjustment.*

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The Ready to Learn Service on PBS
Participating Stations
(as of January 1997)

Alabama Public Television
Arkansas Educational Television Network
Blue Ridge Public Television
Connecticut Public Television
Georgia Public Television
Idaho Public Television
KACV/Amarillo, TX
KAKM/Anchorage, AK
KBYU/Provo-Salt Lake City, UT
KCET/Los Angeles, CA
KCOS/El Paso, TX
KCPT/Kansas City, MO
KCTF/Waco, TX
KCTS/Seattle, WA
KEET/Eureka, CA
KERA, Dallas, TX
KETC/St. Louis, MO
KLRN/San Antonio, TX
KLRU/Austin, TX
KNCT/Killeen, TX
KNME/Albuquerque, NM
KOOD-KSWK/Bunker Hill, KS
KOZK-KOZJ/Springfield, MO
KRMA/Denver, CO
KSYS-KFTS/Medford, OR
KTCA/St. Paul, MN
KTEH/San Jose, CA
KTLC/Oklahoma City, OK
KUHT/Houston, TX
KUSM/Bozeman, MT
KTNW/Pullman, WA
KTWU/Topeka, KS
Louisiana Public Broadcasting
Maine Public Broadcasting
Maryland Public Television
New Hampshire Public Television
Oregon Public Broadcasting
WBGU/Bowling Green, OH
WCFE/Plattsburgh, NY
WCNY/Syracuse, NY
WCTE/Cookeville, TN
WCVE-WHTJ-WCVW/Richmond, VA
WDCN/Nashville, TN
WDSE/Duluth, MN
WEDU/Tampa, FL
WEIU/Charleston, IL
West Michigan Public Broadcasting
WETA/Washington, D.C.
WFYI/Indianapolis, IN
WFSU/Tallahassee, FL
WGBH/Boston, MA
WGBY/Springfield, MA
WGTE/Toledo, OH
WGVU/Grand Rapids, MI
WHRO/Richmond, VA
WHYY/Philadelphia, PA
WILL/Urbana, IL
WIPB/Muncie, IN
WKAR/E. Lansing, MI
WKPC/Louisville, KY
WLAE/New Orleans, LA
WLRN/Miami, FL
WLVT/Allentown, PA
WMEC-WQEC-WSEC/Springfield, IL
WMFE/Orlando, FL
WMHT/Schenectady, NY
WMVS-WMVT/Milwaukee, WI
WNEO-WEAO/Kent, OH
WNET/New York, NY
WNIN/Evansville, IN
WNPB/Morgantown, WV
WNPE-WNPI/Watertown, NY
WOSU/Columbus, OH
WOUB/Athens, OH
WPBY/Huntington, WV
WPSX/University Park, PA
WPTD-WPTO/Dayton, OH
WQED/Pittsburgh, PA
WQPT/Moline, IL
WSIU/Carbondale, IL
WSKG/Binghamton, NY
WSRE/Pensacola, FL
WSMQ/Austin, MN
WSWP/Beckley, WV
WTTW/Chicago, IL
WTVI/Charlotte, NC
WTVP/Peoria, IL
WTVS/Detroit, MI
WVIZ/Cleveland, OH
WUCM-WUCX/University Center, MI
WUFT/Gainesville, FL
WXEL/West Palm Beach, FL
WXXI/Rochester, NY
WYES/New Orleans, LA

The Ready to Learn Service on PBS reaches approximately 77% of the country, more than 73 million American homes and more than 29 million children.

CORPORATION
FOR PUBLIC
BROADCASTING

NEWS RELEASE

NEWS RELEASE...NEWS RELEASE...NEWS RELEASE

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FOR IMMEDIATE RELEASE:
January 8, 1996

CORPORATION FOR PUBLIC BROADCASTING FUNDS FIRST WEEKLY SERIES FOR PARENTS, TWO NEW DAILY SERIES FOR CHILDREN

First series funded exclusively for Ready To Learn education initiative, to feature Internet and radio components

Pasadena, CA, January 8 -- In one of the most ambitious efforts to date to harness the power of public television to teach, the Corporation for Public Broadcasting today announced $8.4 million in funding for two new daily series for children, and two accompanying weekly series for parents, targeted to air in 1997-98 and 1998-99, as part of CPB's Ready To Learn education initiative. Each series will feature related interactive online, print, and outreach components to prepare children for school.

The Corporations's Ready To Learn Programming Initiative features, for the first time, weekly programming for parents, which directly relates to the new daily children's shows and *PTV: The Ready To Learn Service on PBS*. The children's series offer active television that engages each child's interest, then extends it through books and related activities performed after the TV is turned off.

CPB is providing $4.2 million to a partnership of the Children's Television Workshop (CTW) and Columbia TriStar Television Distribution to develop and produce 40 episodes of **DRAGON TALES**, a daily animated half-hour preschool series based on Ron Rodecker's acclaimed dragon drawings, and 13 episodes of the accompanying weekly half-hour parenting series **SHOW AND TELL ME**, to help parents and other caregivers participate effectively in their children's learning. The producers will also create "Parenting Moments," brief between-program spots for television and radio, along with an interactive Internet component for children and families.

CPB also is providing $4.2 million to public broadcaster WGBH Boston, in partnership with Sirius Thinking, Inc., to develop and co-produce 40 episodes of an innovative half-hour daily literacy series, **BETWEEN THE LIONS**, for 4 to 7 year-olds, and a related 13-part weekly half-hour series **KIDS AND HOW TO GROW THEM** for parents and caregivers, along with an interactive online component for the Internet.

"This is a new vision for television," said Richard W. Carlson, CPB President and CEO. "We are providing parents, the most important teachers, with programs that explain the 'why' and the 'how to' they can use to improve their child's school readiness skills. When you consider that a child spends more than 4,000 hours in front of a television by the time he or she begins kindergarten, it makes sense to give mom, dad, and the caregiver a ready reference to help."

- more -

DRAGON TALES, a story-driven animated, musical adventure, takes place in the magical world of dragons. Max and his big sister Margarita, whose parents came to the U.S. from Latin America, are drawn through a storybook to "Dragon Land," a parallel universe that mirrors human reality with a rich cast of lovable dragons. There, the children journey with their friend Blaze, who faces new challenges in each episode. Blaze will ask the children at home to sing, whistle, make silly sounds, laugh, cry, imitate musical instruments, and do animal sounds. Each activity will help children cope with new situations, make choices, and learn important lessons.

The primary educational goal of the series is to encourage children to face new experiences with confidence by helping them to pursue challenges, overcome fears, and make difficult tasks easier through teamwork.

SHOW AND TELL ME is designed to educate parents and caregivers about ways they can help children become ready to learn. Guest experts, hidden camera segments, celebrity parents, people on the street interviews, and funny and enlightening clips from other Ready To Learn programs and Columbia TriStar's vast library of family sitcoms and dramas, will shed light on issues that parents want to know about. Parent-child activities using real parents and kids, role-playing games, and story telling segments will give parents and caregivers specific, hands-on activities to share with their children.

"We are thrilled to continue our partnership with public television, and we are excited about our new relationship with Columbia TriStar Television Distribution," said CTW President and CEO, David V.B. Britt. "We couldn't have asked for a stronger teammate. **DRAGON TALES** will captivate preschoolers, and, with **SHOW AND TELL ME** continue CTW's tradition of bringing children and families the best of what media can offer." Britt also noted that "CTW is delighted to be working with Oregon Public Television, where **SHOW AND TELL ME** will be produced."

"We're thrilled that the Corporation for Public Broadcasting has selected these remarkable projects to be part of their Ready to Learn Program," said Barry Thurston, President, Columbia TriStar Television Distribution. "And, we're delighted to join forces with the Children's Television Workshop. The collective creative and marketing talents of our two organizations form the ideal partnership to produce quality programming that entertains, informs, and hopefully inspires a greater commitment to learning."

BETWEEN THE LIONS is the first new show in decades to promote literacy and teach the skills beginning readers need to master. The series covers reading, writing, listening, and speaking skills. It will motivate children to read and write, and it will provide them with skills instruction. **BETWEEN THE LIONS** will use a mix of language and phonics instruction, music, humor, lovable characters, animation and Zazzu and Zig, the Lion comedy team hosts, who not-too-fiercely guard the doors of the library, to teach children about reading. Once inside the library, children are quickly transported to another dimension: a place where books come to life, and where you can find yourself wandering through the pages of an all-too-real story. Children will be delighted with Click the Mouse, the librarian; Zina and Zack, the intensely curious, mischievous, one year-old lion cubs; Heath the Thesaurus, a long-necked dinosaur who runs the library's reference department; and Books Bunny, a streetwise, wisecracking rabbit with the inflections of a New York cab driver and an all-embracing love for reading.

KIDS AND HOW TO GROW THEM, targeted to parents and other caregivers, is a lively, imaginative, and humorous talk show that will strive to show adults how to connect with their children, how to safeguard their health, and how to spark their creativity.

"No skill is more critical to a child's success in school than the ability to read," said Brigid Sullivan, WGBH Vice President for Children's Programs. "What better service could public television offer our children?"

"These will become signature shows and services for *PTV: The Ready To Learn Service on PBS*," said Carolynn Reid-Wallace, CPB Senior Vice President for Education and Programming. "They have the potential to reinvent how we reach and teach not only children, but their parents and caregivers as well."

Ready To Learn, which began in 1992, is CPB's response to the nation's first education goal -- that all children enter school ready to learn. The initiative helps provide children with the basic skills they need to succeed in school. It joins local public television stations, community organizations, and national producers to help parents use television to teach their children and encourage them to read.

Each of the 44 public television stations participating in the *PTV: The Ready To Learn Service on PBS* broadcasts up to nine hours of PBS children's programming daily. The broadcast service is complemented by major outreach components including educational materials, workshops, activity guides, and books that reinforce programming messages. The Service, which currently reaches more than half of all households, will be offered nationwide in 1996.

CPB funding for the new programs is based in part on a recently awarded $7 million grant from the U.S. Department of Education's National Early Childhood Institute to help create new television programming, purchase books, and develop educational materials and workshops in English and Spanish for the Ready To Learn Initiative. CPB's efforts also help make possible the success of *PTV: The Ready To Learn Service on PBS*.

Reading is a critical component of Ready To Learn. Through CPB's partner First Book, a national not-for-profit dedicated to providing books to children who otherwise might not get them, more than 300,000 free books have been distributed by public television stations at Ready To Learn workshops.

Grant amounts are contingent upon successful completion of contract negotiations.

CPB is a private, nonprofit corporation, created by Congress in 1967 to oversee the development of public radio, television, and online services for the American people. The Corporation is a grantmaking organization responsible for funding more than 1,000 public stations. CPB is the industry's largest single source of funds for national public radio and television program development and production.

Contacts:

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CTW: Ellen Lewis Gideon, Vice President, Publicity and Promotion, (212) 875-6396

# # #

CORPORATION FOR PUBLIC BROADCASTING

Peggy O'Brien
Vice President, Education
Office of Education and Programming

14 February 1997

Ms. Jeanine Smartt
The White House
Domestic Policy Council
Suite 217
Washington, D.C. 20500

Dear Ms. Smartt,

At the request of Naomi Karp, I am sending you a small "packet of goods" to familiarize you with the Corporation for Public Broadcasting's Ready To Learn project. It begins with a brief summary of one or two recent research studies which show--as prior research has consistently shown--that young children can and do learn important kinds of concepts and skills through good, educationally-focused television programs.

Though television can be a powerful teaching tool, it is far from a child's first or best teacher. That's why TV is only one part of the Ready To Learn Service, and why Ready To Learn embraces children, their parents, and their adult caregivers, too.

Through television programming, books, other printed educational material, and workshops, Ready To Learn introduces parents, not only to the critical reality that they are their children's most important teachers, but to concrete and practical ways in which they can use books and good educational television to help their children become ready for school.

What I believe makes this project a comprehensive and powerful one is the fact that Ready To Learn is simultaneously on the air--on free, accessible public television airwaves--and in communities across the country. The whole infrastructure of public broadcasting--educational staff at stations,

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producers, PBS, and CPB--is at work here, bringing young children to the pleasures of reading through programming for kids and parents, the distribution of free children's books and regular publications like *PTV Families* and *Para la familia*, workshops for parents and daycare providers, and partnerships with local institutions like libraries, bookstores, and literacy organizations. Children right here in Washington, D.C. benefit from Ready To Learn, along with children of migrant workers in Pocatello, ID, newly-arrived Russian immigrants in the Bronx, children in poor sections of Miami, and more.

Ready To Learn is the Corporation for Public Broadcasting's number one educational priority. We work hard at it because we know that the stakes are incredibly high--the next generation of our own children, and their children, and their children.

I am pleased to supply you with this information, and I will be happy to provide you with more detailed material at your request.

Sincerely yours,

Peggy O'Brien

cc: Naomi Karp
Carolynn Reid-Wallace

THE CORPORATION FOR PUBLIC BROADCASTING

READY TO LEARN SERVICE

EDUCATIONAL PHILOSOPHY

The Ready to Learn Service is an initiative developed by public broadcasting in response to the important national education goal--*that by the year 2000, all American children will begin school ready to learn.* Public broadcasting seeks to help children achieve this goal--including those for whom English is a second language--by introducing their parents and adult care-givers to ways in which using television and books with children can help them become ready to learn. Ready to Learn works on behalf of America's children by using the very best that public broadcasting has to offer--excellent new television programming that teaches; well-conceived and effective educational materials which include *PTV Families* and *PTV para la familia,* bi-monthly publications for adults and children; new free books for children who otherwise would not be able to own their own books; and newly designed educational outreach workshops sponsored by public television stations in their own communities.

Parents, community volunteers, daycare providers, and teachers can use school readiness opportunities presented by good television programs in conjunction with educational materials and books in order to bring into full circle the dynamic created by parent, child, the viewing of quality programming, and attention to language, the written word, books, and reading.

Ready To Learn is exploring national partnerships with organizations like the National Center for Family Literacy, Avancé, and the American Library Association. Local public television stations are implementing the Ready To Learn Service in collaboration with a wide range of partners including: local chapters of the National Association for the Education of Young Children, the Urban League, Head Start and Even Start programs, local literacy councils, libraries, churches, school systems, and others.

With funding from the U. S. Department of Education, CPB has expanded from the 10 original Ready To Learn stations in 1994, to 44 stations in 1995, to 95 stations in 1996. This means that 77% of the U. S. television households--more than 73 million American homes and more than 29 million children ages 2-11--are reached by the Ready To Learn Service.

COMPONENTS OF THE READY TO LEARN SERVICE

1. *PROGRAMMING*

Ready To Learn stations commit to air at least 6.5 hours of non-violent, educational children's television programming daily. Nationally, CPB identifies and funds new programs for the Ready To Learn Service. One such project in development is ***Between the Lions,*** an innovative new daily half-hour series for 4-to-7 year olds which will teach them to read. Employing a mix of whole language and phonics instruction, ***Lions*** will embed the decoding skills children need to learn within a meaningful, fun, literature-driven half-hour of television. The program takes place in a library which is inhabited by an animated group of puppets and "real" people and where books come to life. Although the series is about reading and writing English, it is being designed in such a way that children who are native Spanish speakers--or native speakers of any other language--will enjoy it and gain needed English skills. Reading scholars including Victoria Purcell-Gates, Dorothy Strickland, and Maria Estela Allende Brisk are at work with the creative team on the project. Key literacy organizations including The Center for the Book, The American Library Association, the International Reading Association, and the American Association of School Libraries are resources as well so that Between The Lions will serve as a catalyst in the continuing national emphasis on reading.

Kids and How To Grow Them is a weekly half-hour series for parents and caregivers, thematically related to ***Between The Lions***. Both shows are produced by WGBH/Boston, MA and Sirius Entertainment, Inc. and are expected to air in 1999.

2. *PUBLICATIONS*

PTV Families and *PTV para la familia* are magazines designed to help adults become more involved in their children's learning. They include information, ideas, and learning activities for both parents and children. Ready To Learn stations distributes 800,000 copies free, every other month, to families across the country.

3. *BOOKS*

Every month, through CPB's First Book program, stations order anywhere from 200 to 2500 children's books to distribute in workshops at Ready To Learn sites in their communities--Head Start centers, homeless shelters, pre-school programs, teen mother programs, Even Start centers, and more. Ready To Learn stations currently provide more than 28,000 free, new books per month to children who would not otherwise be able to own their own books.

4. *WORKSHOPS*

Workshops are person-to-person training sessions provided by public television stations for parents, teachers, and child-care givers. Workshop leaders discuss and demonstrate practical ways in which adults can help their children become ready to read and ready to learn, using books, good television, and other resources.

Public Television Children's Programs: Are They Helping Young Children Get Ready for School?

Nicholas Zill
Elizabeth Davies

Westat, Inc.
1650 Research Blvd.
Rockville, MD 20850

Report prepared for
The Corporation for Public Broadcasting

November 16, 1994

EXECUTIVE SUMMARY

Data from a large national survey of young children, the National Household Education Survey of 1993, were used to examine the extent to which U.S. preschoolers and kindergarten students watch four different educational television programs: Barney and Friends, Mister Rogers' Neighborhood, Reading Rainbow, and Sesame Street. The survey data were also analyzed to determine whether viewing of the programs was associated with more frequent signs of emerging literacy in preschool children, and with less frequent learning and behavior problems in kindergarten students.

The audience for Public Broadcasting Service (PBS) children's programs was found to be extremely broad and diverse. Eighty-eight percent of all preschoolers and 80 percent of kindergartners watch at least one of the four programs once a week or more. Seventy-three percent of preschoolers and 61 percent of kindergartners watch two or more of the shows. Younger preschoolers are more likely to watch than older preschoolers or kindergartners, but even among older kindergartners, more than half watch two or more PBS programs regularly. The programs are reaching majorities of young children in virtually all demographic groups. In contrast to many other educational aids, which are more likely to be used by families with more education and income, viewing of PBS children's programs is just as common or only slightly less common among children of parents who had less than a high school education or poverty-level or near-poverty incomes as among children of parents with more education and higher incomes. Young children who live in communities with high concentrations of child poverty are also as likely to be viewers of the PBS programming as preschoolers and kindergartners living in areas with less child poverty.

Four-year-old preschoolers who were viewers of one or more of the PBS programs were more likely to be able to identify colors by name, count to twenty, recognize letters of the alphabet, and tell connected stories when pretending to read. The viewing-related differences were more pronounced among preschoolers from low-income families than among those from non-poor families. The developmental differences between viewers and non-

viewers remained significant when other relevant child and family characteristics, including frequency of parental reading and preschool program attendance, were controlled by means of regression analysis. The survey did not find that watching greater numbers of the PBS programs was associated with higher levels of preacademic skills. Among three-year-olds, however, those who watched three or all four of the PBS programs were more likely to demonstrate emerging literacy than those who watched two, one, or none of the programs. The survey did not find clearcut evidence that watching a particular show or set of shows was more beneficial than watching others.

Among kindergartners from low-income families, there were indications that having watched Sesame Street prior to beginning school was associated with less negative feedback to parents from teachers about the child's performance or conduct in school. The effect of Sesame Street viewing were only marginally significant, however. Among kindergartners from non-poor families, a history of PBS viewing was associated with a *greater* likelihood of receiving negative feedback from teachers, as was a history of having attended preschool programs.

The survey data support the contention that regular viewing of educational television programs can aid children's preparation for school, but two caveats are in order. First, the survey was not a controlled educational experiment. Families whose offspring watched (or did not watch) PBS children's programs were self-selected and the differences in the children's development may have been due to other factors that were correlated with but not caused by PBS viewing (or non-viewing). Second, preschoolers from low-income families who watched PBS programs were still behind their peers from non-poor families in recognizing letters, counting to twenty, and other signs of emerging literacy. Whatever good it may be doing, educational television is not a cure for the handicapping effects of coming from an educationally or economically impoverished family. The findings underscore the need to work with parents and day care providers and to find ways in which educational television might be made more beneficial to children who come from disadvantaged family backgrounds.

cpb **Research Notes**

No. 99, January 1997

Children Who View PBS Programs

New Findings From Roper Youth Report

CPB participated in the Roper Starch Worldwide Roper Youth Report 1996. Roper interviewed more than 1,200 children ages 6-17 in person in their homes in May and June of 1996. CPB included a special set of proprietary questions for children ages 6-12. These additional questions yielded interesting findings about the children ages 6-12 who watch PBS.

Children who watch PBS are a lot like other children: they share the same demographics as the rest of the population.[1] In key demographic characteristics such as household income, education of the parents, and ethnicity, the PBS viewers were not significantly different than the non-PBS viewers. They also shared some behavior traits: they all watched a great deal of television—over 29 hours per week. They had similar attitudes about social issues: they had the same degree of concern about issues such as violence on TV, drugs, homelessness, and pollution of air and water.

PBS Viewers View and Do

However, PBS viewers showed some differences from the children who did not recall watching PBS. These differences also reflect the educational and activity-oriented emphasis that is found in PBS programs.

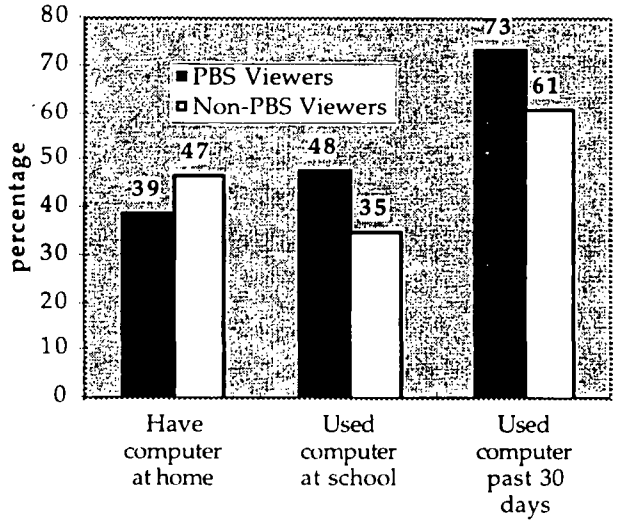
Programs like *Reading Rainbow, Lamb Chop's Play-Along, Bill Nye, the Science Guy, Wishbone,* and *Where in the World is Carmen Sandiego?* are designed to encourage children to move beyond a passive state to learn more about the program content. In the Roper study, children confirmed that they did just that following viewing of the above PBS programs. After watching PBS programs, children have become motivated to engage in activities such as reading a book, making something, researching a subject further or doing an experiment.

[1]About half of the sample indicated PBS viewing.

Even though children watch a lot of television, it doesn't mean that children are not reading. PBS programs promote reading. In this survey, the children who watched PBS were more likely to have read a non-school book. They were also more likely to read a magazine.

Children who watch PBS were more likely to have used a personal computer in the past 30 days, but were less likely to own a personal computer at home. Their computer usage was greater at school compared to non-PBS viewers.

Kids and Computers



PBS Viewers Like School

Children who watched PBS were more likely to say they looked forward to going to school. In addition to using computers more at school, they also indicated a greater use of video and movies in the classroom. Children who watched PBS also were more likely to rate the use of computers and video in the classroom as positive learning experiences. PBS viewers also were more likely to say that teachers influenced them about what they will be when they grow up.

Parents Play an Important Role

While the income of the parents or their educational level did not show significant differences in the non-PBS children's families versus the PBS viewers, the PBS

cc Nicole Rabner
file "Brain Conf."

Quality of Care and the Buffering of Stress Physiology: Its Potential Role in Protecting the Developing Human Brain

Megan R. Gunnar
Institute of Child Development
University of Minnesota

One of the most exciting areas in neuroscience these days is that of "neural plasticity". Neural plasticity refers to the capacity of the brain to change with experience. The evidence now accummulating clearly shows that the blueprint for "growing a brain" is not solely contained in the genetic code. In fact, it is clear that through evolution our genes have come to use "experience" as part of the basic information that builds a brain. The experiences children have provide some of the information that is used by the genome in deciding what to "make" and when to "make it" and thus how the brain gets structured during early development. Along with positive, "growth promoting" events, adverse events also are important in sculpting the developing brain. In this presentation I discuss one mechanism by which these events may do damage to the central nervous system, and I will talk about a major way that it appears nature has "solved" the problem of how to protect the developing brain from the impact of adversity.

Adverse events, be they physical or psychological, can recruit powerful "stress-sensitive" physiological systems. The locus ceruleus-norepinephrine system (the one that regulates adrenaline) is one of these systems. Another system, and the one I will talk about, is the hypothalamic-pituitary-adrenocortical (HPA) system. This system produces a steroid hormone, cortisol in humans, that has ubiquitous effects on metabolism, the immune system, and the brain. In the brain, cortisol does many things, but one "bad" thing it does is to facilitate the processes the cause cell death and that reduce the number of dendrites (connections) among neurons in certain areas of the brain. Adults who have experienced chronic or intense activation of this system (for example those with Post-traumatic Stress Disorder, PTSD) show shrinkage of a certain brain region, the

hippocampus, that is important in learning and memory. Infusion of cortisol into the brains of normal adults causes impairments in selective attention. In rat models of human emotional problems, high levels of corticoids over many days causes an area of the brain, the amygdala, to be overactive. The amygdala is involved in anxious, hypervigilant behavior. Monkey infants whose were exposed to high levels of these corticoids in utero (i.e. prenatally) when their brains were rapidly growing, show many long-term impairments in thinking and are highly anxious and stress reactive as they grow up. Monkeys reared in deprived environments without a real "mother" also show similar impairments, as do monkey infants reared by mothers who are being chronically stressed and whose mothering behavior is severely impacted as a result. Finally, infant rats who get repeatedly stressed early in development grow up to be hyper-stressreactive adults and to show many of thse impairments, as well.

If stress is so bad for the developing brain, one would expect that mechanisms have evolved to protect the developing brain from its effects. This certainly appears to be the case in infant rats who go through a period of time while they are in the nest where it is almost impossible to get the HPA system to produce corticoids (called the stress hyporesponsive period or SHRP). This SHRP is maintained through specific stimulation from the mother. Remove the mother for 24 hours and you get a reactive HPA system coming on-line, provide the necessary, specific stimulation usually derived from the mother, and the HPA system remains in the SHRP mode. In monkeys, a very social animal like ourselves, physical contact with the mother or an aunt (another adult female who "mothers" the baby), serves as a very effective buffer of the HPA system. Even seeing the mother without being able to get to her will lower cortisol responses to stressors in the infant monkey.

We now have good evidence that something like this buffering is also happening in human infants. The HPA system of the newborn is very reactive and labile. Almost any stimulation, even undressing and weighing the baby, will produce large increases in cortisol. However, by 3 months of age there is a dampening of cortisol responses to handling, and by one year of age even such things as getting shots (e.g. childhood inoculations) no longer elevate cortisol. What keeps the HPA system so buffered? It seems

that experience in a relationship with caregivers is the thing. Children who are in secure emotional relationships with their attachment figure(s) do not show elevations in cortisol to stressors (i.e., shots, strange events, brief separations), while children who are in insecure emotional relationships do show elevations (see figure 1). Children who are given a warm and sensitive babysitter during brief (30 minute) periods of separation from the attachment figure also fail to show elevations in cortisol, while those given a cold/distant babysitter do show elevations. Children who are reared in orphanages without anyone to become attached to show abberant patterns of cortisol secretion over the day. Those orphans with higher cortisol levels also show more developmental delays (cognitive, motor, and social). Thus it is clear that we "protect" the developing brain from the deleterious impact of stress hormones by providing high quality caregiving that blocks or buffers stress systems. That is, that prevents the activation of stress physiology even under conditions that the baby finds noxious (i.e., getting a shot). Failure to provide these safe, responsive contexts for development may result in the physiology of stress adversely affecting the development of brain areas involved in learning and memory, attention regulation, and negative emotionality.

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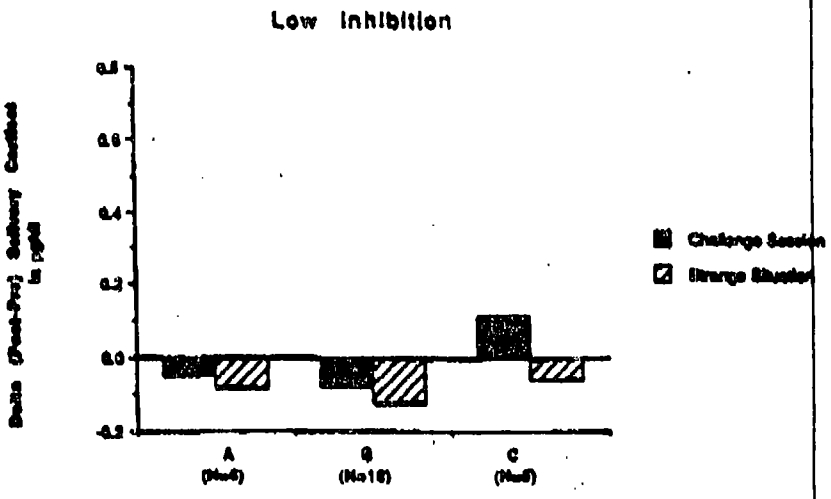
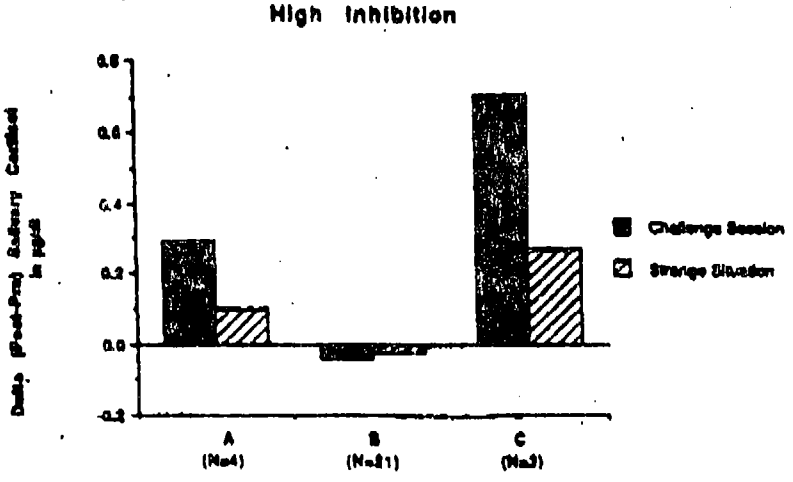
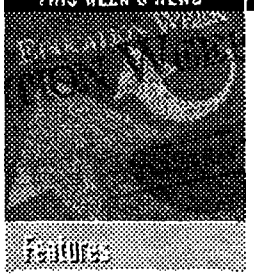




A and C are insecure attachment groups, B is the secure attachment group. The Challenge Session refers to the strange event session. The Strange Situation assesses attachment security. High Inhibition refers to the wary/fearful children.

SEPT. 18, 1996 EDUCATION WEEK on the WEB



Parenting on the Brain

Mildred M. Winter has watched the way teenage mothers sometimes resist their babies' exploring touches. She knows how these young parents brush away the tiny fingers that tug on their carefully coifed hair or threaten to smudge their makeup. Some of these inexperienced mothers are so self-conscious about their appearances that they rarely pick their infants up at all.

See the accompanying article in This Week's News, "Brain Trust," about the neuroscience of education.

But research in neuroscience suggests that babies need to gaze at Mom's face up close and finger her mouth and eyes if the parts of their brains that control vision and sensory-motor skills are ever to reach their full potential. After all, there's a good reason that the distance from a mother's cradling arms to her face measures about two feet: That's roughly the distance at which a newborn's eyes focus.

Such observations have prompted Winter to look for ways to incorporate findings from neuroscience into her work at the Parents as Teachers National Center Inc., the St. Louis-based nonprofit organization that she directs. For 25 years, the program has taught parenting skills to expectant teens and new adult parents who are either poor, single, or never graduated from high school. The idea is to translate research findings for parents and to provide them with the information they need to maximize their children's chances of success in school.

Since its 1981 inception in four Missouri school districts, the program has built an enviable track record. Today, 1,907 programs operate in 47 states. Moreover, studies show that teachers of 1st graders who've grown up in the program rated the youngsters higher than their classmates in reading, math, language arts, social development, work habits, and physical fitness.

"But the research we use now comes out of the fields of education and psychology," Winter says. Wondering if research on brain development might also help parents in the program, she approached neuroscientists around the country. What she came away with convinced her that the additional research would not only benefit parents, but it might also motivate them to improve their child-rearing practices.

With the support of a $478,300 grant from the Charles A. Dana Foundation, the center is now working with neuroscientists from the Washington University School of Medicine in St. Louis to distill 10 principles of prenatal and postnatal brain development and to translate them into scripts, videos, and other audiovisual materials that parent educators can use. Beginning inJanuary 1998, educators will start delivering this information to the doorsteps of 80 families inthe program.

To determine if the added effort makes any difference in those families, the center plans to monitor them over time and compare their parenting practices with those of 80 other families who will be receiving only the regular program information.

"We'll be enhancing what we tell parents now--not throwing it out," Winter explains. "But we think this is the place to start. Every parent wants the best for his or her child so we have a very receptive audience here."

--DEBRA VIADERO

On the Web

For more information on Mildred Winter's organization, Parents as Teachers National Center Inc., visit its Web page.

SEPT. 18, 1996 EDUCATION WEEK on the WEB

Features

Brain Trust

By Debra Viadero

A baby is born with more than 100 billion brain cells, more than he or she will ever use in a lifetime. Some of these brain cells, called neurons, have already been hard-wired to other cells. They control the baby's heartbeat, command its breathing, produce reflexes, and regulate other functions essential to survival.

But the rest are just waiting to be hooked up and played like orchestra instruments in a complex musical composition. Parents, educators, the baby's early experiences--all these factors will determine which neurons connect and which connections will eventually wither and die from lack of use.

Neuroscience offers a wealth of research on the human brain and how children learn. The question is: Will educators put their faith in it?

See the accompanying article in This Week's News, "Parenting on the Brain," about the neuroscience of being a parent.

The circuits that form essentially decide who we are. They can influence whether a child becomes shy or outgoing, musically talented or tone-deaf, silver-tongued or tongue-tied. Chances are a child bathed in language from birth will learn to speak quickly. A baby whose coos are met with smiles, rather than impassivity, will likely become emotionally responsive.

Over the past 20 years or more, neuroscientists have amassed a wealth of knowledge on the brain and its development from birth to adulthood. And they are beginning to draw some solid conclusions about how the human brain grows and how babies acquire language, sight and musical talents, and other abilities.

The question now is: How much of these data can educators use? The answer is uncertain. Some findings hint at definite directions for education. Others, stemming primarily from animal studies, are tentative at best.

"If you tell decisionmakers or parents, 'Your child will have a better brain if you do this or that,' then that seems to have a more seductive appeal than anything we educators can say."
Edward Zigler
Yale University.

But a few points are clear. One is that the brain matters. Helping parents nurture healthy brains in their children will lead to a payoff in school later on. That means that babies, while still in the womb, should receive proper nutrition and protection from the harmful effects of drugs, alcohol, and cigarette smoke. After birth, it means immersing children in environments that are emotionally and intellectually rich and stimulating.

The second point is that neuroscience, with its reputation as a "hard science," could be a potential ally for educators. Educators for years have claimed that the early years of childhood were critical to learning. But their own studies, coming from a body of scientific work perceived as "soft" and lacking in the kinds of graphic evidence that come from brain scans and biological studies, have sometimes fallen on deaf ears.

"If you tell decisionmakers or parents, 'Your child will have a better brain if you do this or that,' then that seems to have a more seductive

appeal than anything we educators can say," says Edward Zigler, the director of the Bush Center in Child Development and Family Policy at Yale University.

The connections neurons make with one another are called synapses. While various parts of the brain develop at different rates, study after study has shown that the peak production period for synapses is from birth to the later elementary school years.

During that time, the receptive branches of the nerve cells, or dendrites, are growing and reaching out to form trillions upon trillions of synapses. The brain's weight triples to nearly adult size. What's more, periods of rapid synapse production in specific parts of the brain seem to correspond to the development of behaviors linked to those parts of the brain.

But at almost the same time the brain is linking up cells, it also begins pruning off or fine-tuning connections. "We know the brain in other species, as well as in man, goes through a period when it makes too many connections," says Harry Chugani, a neuroscientist at Children's Hospital and Wayne State University in Detroit. The synapses that are not repeatedly used die off while others remain. "The child who learns piano will learn those connections and, 20 years later, will learn to play again easier than someone who has not studied it," says Chugani, whose studies have looked specifically at glucose production in the developing brain.

The brain uses glucose at each cell connection as a source of energy. By age 4, Chugani found, a child's brain uses more than twice the glucose that an adult brain uses. Between ages 4 and 10, the amount of glucose a child's brain uses remains relatively stable. But at age 10, glucose utilization begins to drop off until it reaches adult rates at age 16 or 17.

Chugani's findings suggest that a child's peak learning years occur just as all those synapses are forming. Yet, in practice, students rarely study foreign language, complex mathematics, or music until their later elementary years. And the most intense periods of instruction often do not come until college.

"In Japan, they play in college, don't they?" Chugani asks, noting how the rigorous pace of instruction for Japanese students drops off once they enter a college or university. "It's almost as if they understand that."

None of these findings is to suggest that people cannot learn later on in life. The findings do indicate, however, the possibility that critical periods exist for some skills. In other words, nature may open doors for development that slowly begin to close as the years go by. Chugani's work puts the key years at age 0 to 10. But other neuroscientists, such as Yale University's Patricia Goldman-Rakic, believe the critical period may be even shorter.

Nature may open doors for developments that slowly begin to close as the years go by.

Some of the most compelling experiments in early brain development have focused on vision. Scientists have known for years that babies afflicted with cataracts in the first two years of life will never have perfect vision once the cataracts have been surgically removed. Similarly, Torsten Wiesel and David Hubel, in a 1970s experiment, found that sewing shut one eye of a newborn kitten rendered it blind--even after the eye was reopened. The reason: Too few neurons had connected from the closed eye to the visual cortex.

The same idea may also bear on learning in other areas, such as language. Patricia K. Kuhl, a researcher at the University of Washington in Seattle, has shown in a series of recent studies that infants are drawn to speech sounds common to their

native language even before they speak.

Kuhl studied 6-month-old babies in the United States and Sweden. Each infant sat on a parent's lap while a nearby loudspeaker continuously repeated a speech sound, such as "ee." If the sound changed from the original, the infants were taught to look at the speaker where an animated toy would pop out.

Once the infants had learned this trick, Kuhl and her colleagues tested them to gauge their sensitivity to sounds in their native tongue vs. sounds peculiar to a foreign tongue. For example, the "ee" sound common in English is not found in Swedish. The Swedish "y," on the other hand, is absent from English. Sure enough, both American and Swedish babies turned their heads more for the sounds from the foreign language. That is, American babies could distinguish small acoustic differences in Swedish sounds but could not hear the same small differences for English. Swedish infants turned more often to the English sounds. So, by age 6 months, babies from both cultures were behaving in a "language specific" way.

Yet, other studies suggest that even younger babies--newborns--are still "language generalists" in that they distinguish between sounds of all languages. What happens in the intervening months?

"We started looking at caretakers," Kuhl says. The researchers noticed that caretakers, in addressing infants, tended to speak more slowly, to stretch out sounds, and to use higher pitch voices and curvy intonations. Aided by this most natural form of instruction, she says, babies over time develop a "perceptual magnet" for familiar sounds. In other words, by 6 months, the babies' brains may have already hard-wired particular pathways for their native language. That's why adult speakers of Japanese, for example, pronounce an English word such as "lake" as "rake." In their native language, they hear "l" in the same sound cluster as "r."

"I'm not so sure I believe there is an absolute critical period for language learning," Kuhl concludes, "but I believe it's difficult learning a second language past a certain point, and that is due to this interference effect" that comes once the language "magnets" are firmly in place.

Does this mean parents should hang Berlitz tapes from their children's cribs? No, Kuhl says. But it does suggest that second languages should be taught as early as preschool and that children with otitis media, a chronic inflammation of the middle ear that hampers hearing in young children, may develop speech problems later on.

In music, too, researchers have used magnetic-resonance imaging to examine the cortex, or the outer "bark," of the brain. Each sense has its own relay station in the cortex. They found, for example, that the earlier a string musician had begun playing an instrument, the greater the amount of cortex dedicated to controlling the finger movements needed to play that instrument.

And psychiatrists have long known that babies whose parents fail to appropriately mirror or reward their emotional responses sometimes lose the ability to display a full repertoire of emotions. Even at 3 months of age, infants of depressed mothers mirror their mothers' moods while playing with them.

Of course, nature's doors of opportunity are not completely inflexible. The brain is noted for its plasticity--its ability to adapt and change. And studies have shown that new synapses form over a lifetime with exposure to new experiences.

But there is little question among brain researchers that early experience, education, and environment play a primary role in determining who we are. That notion runs counter to several long-entrenched views of learning, says Frank Newman, the

president of the Education Commission of the States, which held a conference on neuroscience and education in July with support from the Charles A. Dana Foundation. "It is widely assumed, for example, that most of us are born on a bell curve," he says, referring to the 1995 book asserting that intelligence is fixed at birth.

Brain studies, on the other hand, suggest the opposite. They indicate that parents and educators have a golden opportunity to mold a child's brain. And that calls for a full-court press during the early years--that is, a rich child-care environment without undue academic stress.

Psychologists like Zigler have advocated for such a push for a long time. And education researchers have offered their own statistical ammunition in that struggle. Among the strongest of those efforts is a 20-year study by Craig T. Ramey, a researcher with the Civitan International Research Center in Birmingham, Ala.

Children with preschool experiences had significantly higher IQs throughout elementary school.

Beginning in the 1970s, Ramey and his colleagues provided social services and five years of preschool to groups of black and disadvantaged children. Compared with similar groups of children who received no such services, or who only received special help later on in elementary school, the children with preschool experiences had significantly higher IQs throughout elementary school. Moreover, the gains they made lasted at least through age 15--the last time researchers tested the children.

Yet, says Zigler, policymakers have largely ignored such evidence. "We know rotten environments hurt kids, yet we don't have a problem putting millions of kids in rotten day care every day," he says. "One implication of all this is that mothers ought to be home at least several months after a child's birth--if not a whole year. But in the United States, we have only 12 weeks unpaid leave, and young families can't afford to take unpaid leave."

At the least, says Zigler, neuroscience offers additional--and somewhat more glamorous--evidence strengthening educators' case.

But critics are quick to caution against a hasty marriage between the two disparate fields. "There's a misunderstanding that if science discovers a fact it is irrational, immoral, or unintelligent not to use that fact in schools," says Jerome Kagan, a Harvard University psychologist. "But schools are a creation of the populace. For example, he says, it's probably true that boys are biologically better prepared to do mathematics than girls or that men make better fighter pilots than women.

"Does that mean we should have separate classes for girls or prevent women from becoming fighter pilots?" Kagan asks. "Of course not. Society has every right to say, 'Yes, that's an interesting fact, yet my values tell me to ignore that fact."

Kagan, for one, is wary of resurrecting the centuries-old notion that a child's entire future is determined in the first year of life. "For learning to read, write, or do arithmetic, yes, children vary," he says. "But it is a mistake to assume if you have the right experiences the first year, you will be prepared, or, if not, you will not be prepared." Certain Guatemalan tribes, for example, sometimes raise their infants in isolation to protect them from "the evil eye." Yet, those children still develop language.

Ever the cautious researchers, some neuroscientists also worry that educators will jump on findings before they have been conclusively proved. In the 1980s, for example, some educators, psychologists, and entrepreneurs extended research

findings from neuroscience to suggest that either the left or right hemisphere of an individual's brain would be dominant. Left-brainers were thought to be highly verbal, sequential learners who preferred logical and analytic thinking. Right-brain learners, on the other hand, were thought to have difficulty expressing themselves verbally but excellent spatial memories and highly developed recall abilities, among other characteristics. Consequently, curricula were developed to appeal to one or the other learning style.

But, say Renate Nummela Caine and Geoffrey Caine in Making Connections: Teaching and the Human Brain, the original studies that gave rise to the theory involved severing the corpus callosum, the band of nerve fibers that connects both brain hemispheres, to provide relief from epileptic seizures. That procedure prevents the two halves of the brain from communicating. But normal brain activity, on the other hand, involves interaction between both sides of the brain.

"The most accurate statement that we can make at this point is that research on hemisphericity is inconclusive," they write.

Early childhood is not the only developmental period for which neuroscience can inform educators. Studies have shown, for example, that stress and constant fear--at any age--can circumvent the brain's normal circuits.

Joseph LeDoux at the Center for Neuroscience at New York University was among the first to show that the amygdala, the part of the brain that controls fear, rage, or other strong emotions, can perceive things that trigger those emotions before the rational, thinking part of the brain does. What's more, this almond-shaped cluster perched just above the brain stem can actually command the body into action. It can, in the words of Daniel Goleman, the author of the best-selling book Emotional Intelligence, essentially "hijack" the rest of the brain.

The more this pathway is used, the easier it is to trigger--a notion that may help explain why battered or abused children find it difficult to learn. Verbal or visual cues that remind them of their experiences may be constantly shifting their amygdalas into gear, getting in the way of more rational thinking.

But emotion may also serve to enhance memory. Larry Cahill, James McGaugh, and their colleagues at the Center for Neurobiology, Learning, and Memory at the University of California-Irvine, have found that people were better at recalling stories or slides that had aroused strong feelings in them than those that were devoid of emotional context.

Researchers found that people were better at recalling stories or slides that had aroused strong feelings in them than those that were devoid of emotional context.

In another experiment, the two researchers also discovered they could improve memory in laboratory rats by injecting them with Adrenalin. Administering beta blockers, on the other hand, to inhibit the effect of the Adrenalin, tended to erase memory improvements.

"I think this is something that ought to be used in the classroom all the time," McGaugh says. "Teachers should present information in an exciting way. We shouldn't act as though there is a difference between cognition and emotion.

"Good teachers," he adds, "already do this."

Whether educators will begin to take more cues from neuroscience remains to be seen. The Dana Foundation, which co-sponsored the July conference on education

and neuroscience, has launched a small grant program designed to encourage partnerships between the two fields. In the meantime, McGaugh suggests that teachers should look to the field in the same way astronomers once looked to the National Aeronautics and Space Administration. They should ask: "Here's what we want to know; how can you help us?"

Some Neuroscience Terminology

amygdala: An almond-shaped cluster just above the brain stem that triggers emotions.

axon: A slender fiber--along which impulses travel--branching out from the cell body to the dendrites of other neurons. Most neurons have only one axon.

cell body: The part of the neuron where information is received and stored.

cerebral cortex: The "bark" of the brain. It is the layer of gray matter that covers the cerebrum. Each of the five senses has its own relay station and its own area of the cortex.

dendrite: The short, branching extensions of a nerve cell that receive stimuli from other cells. It is one of three parts that make up the neuron. The other parts are the cell body and the axon.

neuron: One of the impulse-conducting cells that make up the brain, spinal cord, and nerves. Humans are born with more than 100 billion neurons, most of which are yet to be connected to one another.

plasticity: The brain's ability to change and adapt over time.

synapse: The connection formed between one neuron and another through which message impulses travel. Scientists believe the stimulation that babies and young children receive determines which synapses form in the brain--that is, which pathways become "hard wired." Anindividual brain cell may be connected to 10,000 or more other cells.