Chapter Three: A Child's Tale

by Maryanne Wolf and Stephanie Gottwald

Maryanne Wolf's early literacy knowledge is based on her research into deep reading and on periods of enlightened linguistic processes. In her own rich language of conveyance, she brought great inspiration to the Montessori teachers at the Columbia, South Carolina conference. Her presentation on the research of early reading, the acquisition of cognitive and affective skills, optimal exposure to books, and the benefits of reading out-loud corroborates precisely with Montessori theory and practice. She also documented the power of focused, joint attention between the adult reader and child as a key developmental force in the formation of early literacy. In this extract from her newest book, Wolf writes of the developmental phases a child goes through, from prereading to linguistic awareness, and the importance of a literate environment to increasing the scope of early reading. Literacy expands the child's world beyond cognitive ability as it opens communication, symbolism, and immersion into the imagination of literature.

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On Turning Ten

The whole idea of it makes me feel
like I'm coming down with something,
something worse than any stomach ache
or the headaches I get from reading in bad light-
a kind of measles of the spirit,
a mumps of the psyche,
a disfiguring chicken pox of the soul.

You tell me it is too early to be looking back,
but that is because you have forgotten
the perfect simplicity of being one
and the beautiful complexity introduced by two.
But I can lie on my bed and remember every digit.
At four I was an Arabian wizard.
I could make myself invisible
by drinking a glass of milk a certain way.
At seven I was a soldier, at nine a prince.

But now I am mostly at the window
watching the late afternoon light.
Back then it never fell so solemnly
against the side of my tree house,
and my bicycle never leaned against the garage
as it does today,
all the dark blue speed drained out of it.

This is the beginning of sadness, I say to myself,
as I walk through the universe in my sneakers.
It is time to say goodbye
to my imaginary friends,
time to turn the first big number.

It seems only yesterday I used to believe
there was nothing under my skin but light.
If you cut me I would shine.
But now when I fall upon the sidewalks of life,
I skin my knees. I bleed.

You tell me it is too early to be looking back,
but that is because you have forgotten
the perfect simplicity of being one
and the beautiful complexity introduced by two.
But I can lie on my bed and remember every digit.
At four I was an Arabian wizard.
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by drinking a glass of milk a certain way.
At seven I was a soldier, at nine a prince.
—Billy Collins[1]

It is, for most but not all of us, a wonderful thing to remember childhood. For the very fortunate among us, childhood evokes the most halcyon of memories, particularly, as Marcel Proust described in poignant detail, those days immersed in the 'divine pleasure' of a favorite book. Not all childhoods are created equal. Many children never dream of becoming a soldier or a prince, like Billy Collins once did, because they never encountered one, either in their environments or in the books and poems they never heard or read.

The gap between literate and non-literate children is not an absolute one in this country or any other. Rather it is a continuum with a very large range that is heavily influenced by the single chance fact of where the child is born and grows up. For the approximately 57 million children in the world who are completely non-literate, most, though not all of them, live in places where there are no schools and no hint of written materials. Another 150 million or more (no one knows this precise figure) live where the schools are so overcrowded and the teachers so overtaxed and undertrained that it is almost as if there is no school. Most of these children are unlikely to acquire anything beyond the most basic of literacy skills.

Most children in the developed world will acquire some degree of reading skills, but with a more insidiously subtle version of the same continuum in which how-and-what you read is also based on how-and-where you live. In the United States, for example, there remains a long discussed, seemingly intractable gap between the reading skills of many, more privileged European-American students and many, less privileged African-American and Hispanic students. Although there are plentiful anecdotal and individual cases of schools where the gap has been closed, the National Assessment of Educational Progress[2] notes that the gap has changed very little since 1992, in spite of sustained efforts and increased financial attention in many parts of the US. Unlike countries like highest ranked Finland, which distributes educational resources according to the needs of the child over the Kindergarten to 12th grade schooling period[3], the resources of most US public schools still heavily depend on the taxes within their communities, and the involvement of that community in the schools. The gap that has emerged in the US represents another variation of the Matthew Effect, where the rich get richer and the poor get poorer.[4]

In this chapter we will argue that the present literacy gap begins from the very first day any child is born into a non-literate or semi-literate home, where there is little exposure to print and books, and where little reading ever occurs by an adult or between any member of the household and the child. Within this book's overarching theme, *what it means to be literate*, there is an implicit question what it means *not* to be literate. As alluded to in our opening chapter, no discussion of literacy can be divorced from cultural factors that are intrinsically untidy and easily misinterpreted. Although these factors are never absent from the authors' consciousness, they remain outside our scholarly goals in this book. Rather, we seek here to understand the additive cognitive, linguistic, and affective effects of literacy on the young child's life, in order to better foster what is most important about literacy in all children whatever their cultures or environments. For those reasons, we wish to structure this chapter in terms of a developmental comparison of the first years of life growing up in a literate environment, in comparison to a home where there is no exposure to print. This is a difficult task, for there is much more known about the former than the latter. We do so,

however, because the stakes are higher than ever and the Matthew Effect is worse than ever for the children of the near future.

Prereading Can Last a Very Long Time

As discussed at some length in several chapters in *Proust and the Squid*, the development of reading passes through various phases from pre-reading through the acquisition and development of fluent comprehension and deep reading skills. One of the most important reading theorists of the 20th century, my former teacher Jeanne Chall[5], proposed six stages for a sequence for these skills that should be mastered in each developmental level of becoming literate. Although the later phases of reading will be interwoven into later chapters, in this chapter on the Child's Tale, we will concentrate on Chall's pre-reading and beginning periods as the backdrop for understanding what happens before the child ever enters Kindergarten in a literate environment, but not in a non-literate one.

Two major questions will scaffold this comparison and highlight the "additive effects" of literacy in these two critical moments out of a child's life. First, what is learned that is pertinent to oral and written language during the prereading stage in both environments? Second, what changes result from the child's acquisition of literacy?

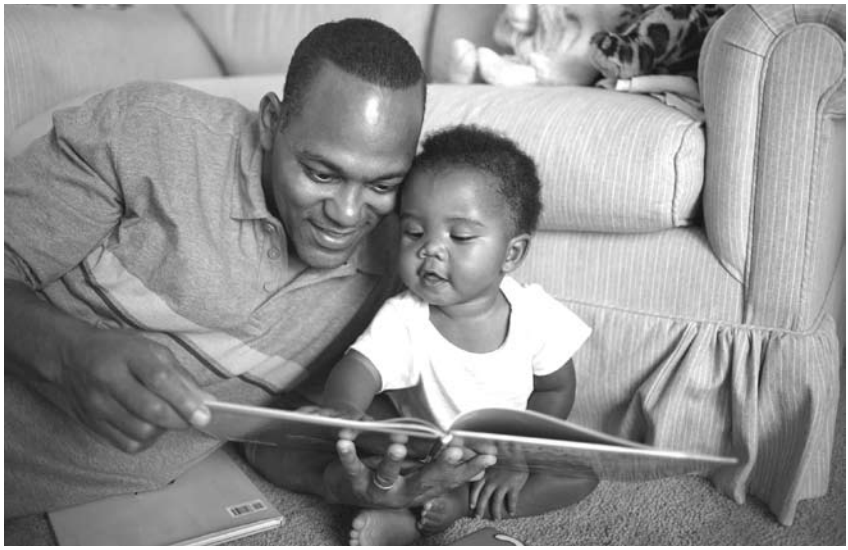
One of the simplest, yet single most important foundations for literacy concerns whether or not a child is *read to* from early on. Indeed studies from Carol Chomsky[6] in the 1970s to Catherine Snow and her colleagues[7] in the recent past show that being read to remains one of the most powerful predictors we have of later reading ability. There is some educational research and some important applications in pediatric medicine that bear on this issue. For example, in a survey conducted by the National Survey of Early Childhood Health, it was found that only 52% of the 2000 parents in the study read to their children every day, but gave no detail on when those families began to read to their children. In another smaller study in Ontario, with parents who ranged from low to upper middle income, some of the parents reported beginning to read to their children sporadically at seven months and regularly at eighteen months of age.[8] To be sure, no studies have been conducted to ascertain whether reading to a seven

month old means sitting and reading a story to the end, or thumbing through the book til the child finished *chewing* on it. We feel the latter can be as conducive for enjoying a book at this age, as the former!

Pediatricians have long understood this. Indeed they have demonstrated across the country and in some parts of Africa that the simple act of giving young parents (most of whom had little training for their new roles!) a small bag of age-appropriate books at every well-visit quickly becomes an invitation to read to their children. Our colleagues Barry Zuckerman and Perry Klass and their associates joined forces to create a national Reach Out and Read (ROAR) program that has had singular success in alerting parents to the importance of reading to the young child[9]. Pam High[10], at the Brown University School of Medicine, reported that one of the results of their local ROAR intervention was the change in how many additional books came into the household. Many parents had no idea that reading to a toddler, much less an infant, was even appropriate, much less desirable.

Indeed the natural response of many an unknowing parent is why would any sensible parent read to a baby if the child cannot possibly understand the story or pay attention to it for any length?! There are many good answers. Each of them helps to provide an overview of what goes on in an enriched pre-literacy environment. First, decades of research into children's emotional and social development have shown that children not only crave physical contact and attention, they, in fact, could die without it.[11] The human brain, but especially the infant brain, is wired to feel pleasure from touch and from the human voice. What makes the act of reading so special in the life of the child is the way this natural emotional and tactile interaction becomes linked with it. As *Pat the Bunny* and *Runaway Bunny* become more and more the stuff of routine, the developing infant learns to associate the reading of books with the most fundamental of human feelings—love and comfort.

In this volume, we will be constructing with the reader an understanding of how the reading brain comes into being. It is wonderful to think that the first building blocks of what will become the reading brain circuit are the feelings activated when the beloved parent reads to the child. Although one hates to think of Pavlov's infamous



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dogs at such a tender moment, it is likely enough that over time the act of reading to one's child contributes to making the very sight of a book associated with pleasure and comfort. (Note: It is probably the case this moment in the chapter that the 21st century reader cannot suppress the 21st century parents' question: Will tablets and laptops do the same thing as a book on a lap? It is an important question, and a tough one. For now, however, we will leave you to your own devices, but will return with something of a vengeance to this question in Chapter Six.)

Before going further, we wish to add a personal, additional implication of what it means to connect reading to the sense of touch and the feeling of being loved. We have come to believe that such a fundamental association to literacy can prove to be an emotional lifeline for those children who, years later, may find themselves struggling to learn to read, something that is, at least at the moment, difficult to predict. In our clinical work, both of us have worked with children who have had to endure enormous struggles over many years before they became proficient readers. While it would be difficult to prove, we strongly suspect that the resilience and perseverance that many children show in their efforts to learn to read may represent a byproduct of their earliest, powerful, and positive associations with reading.

But we have actually only discussed the first reason why reading to one's child is important. A second reason concerns research in infant research on learning and language development on the role of *joint or shared attention.* Simply put, infants pay very close attention to the objects that adults point to or look at. Reading to an infant provides a superb opportunity for *sustained joint attention*. The young child and her typically doting reading partner share a narrative, look at and examine the illustrations, and often as not, create a kind of dialogue with the book's content as the focus. Children learn a great deal more than you might think as a function of social engagement over a book. When parents point something out to a one-year-old, they are providing enormous assistance in the young child's overwhelming task of determining the relevance or importance of an idea or object. There is much to learn and pay attention to in what William James famously called the "buzzing, teeming" life of an infant. The cognitive, social, perceptual, and linguistic-laden world of books helps them learn many of the things that are most important.

Thus, the acts of paying close attention and hearing a story not only have great implications for a child's emotional attachment to reading, but also have huge implications for a child's cognitive and linguistic development. Lest we forget, children are very busy with the process of becoming native speakers of an oral language all the while that one is reading to them. Those who study language acquisition disagree, sometimes fiercely, about how much linguistic knowledge is "wired" into our neuronal networks and what must be gained from exposure. What is never argued is that exposure to literature gives each child a tremendously expanded and elaborated view of words and sentences, both more than and different from everyday speech.

To illustrate some of those differences, let's take one of the most frequently asked questions by parents of young children related to reading: why does their child want to read the same book over and over again? While it is true that reading *Goodnight Moon*[12] for the 1000th time might tax the patience even of the most devoted parents, the commonality of this behavior among young children is revealing on multiple fronts. (Both of your authors can still recite *Goodnight Moon* from memory, which continues to embarrass and secretly please

their four collective offspring!) The reality is that children love repetition, and repetition is a perfect recipe for giving them the "multiple exposures" to things they need to learn from sounds to symbols. The young brain is busily constructing neuronal networks that are dedicated to these sounds, words, images, objects, faces, and other important sensory stimuli that make up their environment. Each time this brain is exposed to a phoneme or group of phonemes in a word, for example, the better "represented" that phoneme or word is and the more connected to its meaning(s) and functions.

Thus, children are wired to thrive on what might seem to adults the sheer tedium of frequently repeating patterns. Reading or written language gives this exposure "for free". Repetition aids not only the setting down of representations of information, but also the discovering of patterns in what they see and touch and hear. Both repetition (which sets down information) and the discovery of patterns in this information are key contributors to developing forms of thought processes like analogy and inference and to exponential increases of knowledge. Consider the fact that each time the child hears *Good Night Moon*, she mines something new that had not been clear or fully formed as a concept from previous readings. She gradually sees, for example, that the little mouse appears in one different place after another. It is a revelation!

Of equal, albeit immeasurable importance, each reading conveys different layers of linguistic knowledge for the developing brain. Word knowledge exists on a continuum. As each word is acquired in the young child's lexicon, it moves from the barest familiarity to an indepth knowledge of that word with all manner of associations and contexts[13]. Most babies do not know that "good night moon " is made of three words, two of which make up one of the "polite forms" of the language, and one of them is a noun referring to a thing in nature. But after many a reading, they are beginning to parse this out; furthermore, they are using this linguistic knowledge to build out from. Rereading quite literally deepens children's knowledge of words with each exposure. All to say, every parent should resolve to repeat, reread, and not…..skip! You will be detected.

From a linguistic perspective, going below the surface of Margaret Wise Brown's classic story also provides a glimpse into what

children learn about language that they will not be able to learn if not exposed to literature. At the first reading of a story, to be sure, there may seem very little that the child would likely comprehend or remember about its rather unlikely narrative. That simply does not matter in the beginning of the written language knowledge continuum. A story like *Goodnight Moon* is pleasurable from its very first reading because of the broad sound patterns and rhythms in the verse.

> In the great green room
> There was a telephone
> And a red balloon
> And a picture of
> The cow jumping over the moon (PERMISSION) [sic]

From the outset, there is rhythm! *Goodnight Moon* soothes both parent and child with its predictable rhyme patterns, repetitions of words, and gentle alliteration. These easily audible patterns do more than soothe. They highlight particular units of sound, the *phonemes* in words. This highlighting is, in Pooh's famous terms, A Very Useful Thing for young children who are trying to figure out "what means what" in their environment's otherwise constant stream of speech sounds. (Think of your own experiences when hearing a foreign language!) More specifically, when we read the /gr/ sound of "*great green room*", the typical reader automatically, unconsciously gives those elements slight emphases; further, we read them slightly louder than the other words and insert pauses between the words. Most readers do something similar with the "and" at the beginning of lines 3 and 4. The next seven lines begin with the word "and", as the reader names all the objects in the room, and the child silently, effortlessly learns more about each of them.

The brain of a young child is wired, if you will, to attend to the sounds represented by patterns in whatever spoken language they are surrounded by. Just like the unconscious ways a mother or an older child automatically exaggerates the prosody of their voices when speaking to a young child (this is called "motherese"), reading stories aloud to a child reinforces and felicitously *exaggerates* the patterns in their spoken language. In the process the child receives increased exposure to elements that occur in less emphasized fashion

in spoken language. For example, humans rarely employ rhyme or alliteration when speaking to others, but in written language these elements occur very frequently and serve as *phoneme-spotlights.* Children's literature, therefore, creates an invisible, tiny sound laboratory where the line between music and speech is blurred and the little phonemes of oral language are better heard. The advantages of such a frequently repeated experience are not only that children learn to listen carefully and patiently for the auditory surprises in the sounds of the words in the story, but their brains become more skilled at storing and "representing" the smaller and smaller pieces of the sound stream. It is the perfect preparation for later matching those stored phoneme representations to visual symbols—letters—when it is time to learn to read.

Thus, when children from six months to six years are exposed to the various sounds and rhythms awash in children's literature, they are better prepared for the task of decoding the words in text when they begin to read. Some of the most fascinating older research that began in England on this topic almost three decades ago illustrated how exposure to the rhymes of Mother Goose and other similar children's materials made a significant difference in later reading performance[14]. This only makes linguistic sense. One of the single most important predictors of reading performance is a child's awareness of phonemes. There is little that consolidates this phoneme knowledge more for the young child than *hearing* words that rhyme and play with the ear and mind. Later on, there is little that propels this same knowledge even further than *reading* the words that contain these phonemes. It is a wonderful example of the great, continuously reciprocal relationship between the various interrelated aspects of oral and written language.

There is more. The particular language of books presents children with examples of words and sentence structures that they are unlikely to hear in spoken language. Most of us have a tendency to be fairly simple and well, fairly redundant in our everyday speech patterns. We talk about everyday matters among ourselves and rarely use more than the most common four to five thousand words. We also rely heavily on declarative sentences, sentence fragments and questions. It might be said that in certain developmental periods, and in certain circles, there are even *less* complex structures

occurring in speech (variations of the original Valley Girl speech in California come readily to mind). The point is that in ordinary speech, we can understand and create many more patterns than those sentence types, but we just don't do so very frequently. The language of stories and poems and books gives exposure to different syntactic patterns in oral language and in the process pushes conceptual development as well. Compound sentences do more than link two thoughts; they give practice to the act of connecting thoughts—analogical thinking by any other term! Such connections, in turn, often lead to new thoughts. As we described briefly in the last chapter, the syntactic structure of our written sentences often reflects the complexity of our thoughts. Written language *pushe*s that complexity in the most subtle and gentle of ways in childhood's stories that grow in complexity themselves.

Think back to an example in your own life when you were asked to read something totally outside your ordinary discourse like the work of Shakespeare with words and phrase structures that were totally new to you. Shakespeare introduced hundreds of new uses for old words, along with whole new words and phrases into common usage: from words like *gossip*, to phrases like "*in a pickle*" and "*strange bedfellows*", to lines that are iconic in our oral and written language *"To be or not to be", "If music be the food of love"*. The scholar F. Max Mueller[15] estimated that Shakespeare used 15,000 different words in his works, more than triple or quadruple a typical speaking vocabulary. Reading Shakespeare as an expert reader, whatever the age, semantically and syntactically expands the horizons of every reader and goes well beyond the limits of typical spoken language.

Reading to a child is an early microcosm of this later experience. Think back to the beloved story of *Winnie the Pooh*. It is a beautiful example of how a story can employ sentence structures never heard in conversations.

> Here is Edward Bear, coming downstairs now, bump, bump, bump, on the back of his head, behind Christopher Robin. It is, as far as he knows, the only way of coming downstairs, but sometimes he feels that there really is another way, if only he could stop bumping for a moment and think of it. [16]

Because adult readers so readily comprehend what is happening in these sentences, the complexity of the language may not be obvious. But ask yourself this question, what does the *it* in the second sentence represent? Typically, we understand pronouns to stand in for a person or a thing. At a bare minimum, *it* should refer to a noun or phrase that was present in a previous utterance. But here, *it* represents the idea of *a way of coming down the stairs*, which is not mentioned until after the *it* appears. Now let's observe the second use of *it*, which occurs in the same sentence. Here *it* stands in for *another way*, best understood as another way of coming down the stairs. Both of these uses of this simple, unassuming pronoun are actually syntactically and cognitively complex. The reader and the listener have to envision with very little explicit explanation, how Edward Bear is going down the stairs, and also try to imagine some other way of coming down the stairs which is also unspecified.

To be exposed to these sentences over several readings of *Winnie the Pooh* opens up new possibilities for the use of one of English's most common pronouns, which a child would be unlikely to hear when talking to parents or peers. Understanding the complex language world of children's literature when being read to is a vital precursor to the comprehension of words and sentences in text that children will later read independently.

There is rich and ample evidence that children who have been read to by the people around them will demonstrate richer vocabularies than children growing up in non or less literate homes. A landmark study by Betty Hart and Todd Risley[17] exposed the vast gap in vocabulary knowledge as a result of the sheer quantity of words that children hear in homes with a good deal of language being spoken, versus homes where children hear less language. Children raised by parents with professional backgrounds are estimated to hear approximately 48 million instances of various words by the time they reach four years of age. In contrast, children raised by parents with far less education hear only 13 million instances of words in this same time period. This study, which is more cited in studies of vocabulary knowledge than any study we know, amplifies the importance of semantic knowledge as a contributor to academic knowledge.

What is less often discussed or cited are the differences in the *quality* and topics of those conversations. Hart and Risley found that children in professional homes heard 750,000 times before the age of four that they were "right" and 250,000 times that they were "wrong". In the homes of families on public assistance the children heard 250,000 times that they were wrong and 125,000 that they were right.

There are no quick judgments that apply here. The parent who has just come home from her second job will use language as often as not to warn and/or protect the well-being of her child. There will be far less time to elaborate any interesting question by the child, or to commend them for it, much less have the time to read to them. As stewards of the next generations of children, however, we have to confront the implications of such data not only for vocabulary growth (and what it portends), but also for social-emotional development. There are various studies that show a child's willingness to speak and to participate in activities like "show and tell" in kindergarten will reliably predict their later academic success. If young children for five years are more frequently told they are doing something wrong than right, the likelihood of their "willingness" to show their knowledge when they enter school is decreased.

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There is to our minds a too little discussed gap—between the child who enters kindergarten primed with the confidence and assurance to ask many questions and tell stories, in contrast to the child who has never been told that his once many questions and his wild stories are the "stuff as dreams are made on"[18]. The quantity and content of oral and written language in the lives of young children will have an impact far beyond the early first years. From a linguis-

tic perspective, we do not need another study to keep proving that the vocabulary knowledge young children possess in kindergarten predicts their performance years later at the end of high school.[19] For the families of children from impoverished language backgrounds, this prediction underscores the devastating, lasting implications of what occurs far earlier than when their children enter the kindergarten doors. The gap begins five years before.

There is a highly related issue that is almost as important as language development, that also comes from the books of childhood: the developing capacity to take on another person's perspective and imagine the thoughts of others. Some of the most loved children's literature from *George and Martha, Frog and Toad,* to *Charlotte's Web* provide this affectively and cognitively expanded experience inside literature. Indeed one of the essential precursors to the comprehension of text involves being able to understand how another person may think and feel. Underlying this ability is what is referred to as "Theory of Mind" and its correlative, *empathy*, as we will discuss more in Chapter Five. A great deal of research has been conducted on the developmental trajectory of the human ability to imagine what others are thinking. It rests on understanding the thoughts and motivations of others even when they are unexpressed.

A frequently employed research paradigm to investigate the developing ability of a child to understand the thoughts of others is called the "false-belief" task.[20] In it, a child might be shown three sequential scenes. In the first scene a boy places a piece of chocolate on the shelf and then leaves the room. In the second the boy's mother enters the room and places the chocolate inside the refrigerator and then leaves the room also. Finally, in the third scene, the boy re-enters the room and looks. After watching these scenes, the child subject in the study is asked where the boy thinks the chocolate is. To perform this task successfully, the child-subject must hold in mind both the actual location of the object and the earlier location when the boy placed it on the shelf. In addition, the child has to take on the perspective of the boy (theory of the boy's mind) to figure out the answer. Such a cognitive process entails inhibiting knowledge of the actual location and expressing the location believed by the boy.

Until recently, it was thought that children can only perform this task beginning at age four. It turns out that some children as young as fifteen months old turn their gaze to the spot where the object is believed by the boy to be and not at the actual location. Even though they are unable to express this thought in language, they are beginning to acquire a theory of others' thoughts. We believe that the developing ability to imagine the thoughts of others and to anticipate their actions is one of the earliest human precursors of the development of later deep reading skills, and it begins with stories of toads and frogs.

It is this same capacity that will someday allow an older child to imagine how lonely Harry felt growing up before going to Hogwarts, or how curious Lucy felt when discovering the wardrobe as a passage to another world. For young children, as they listen raptly and try to understand the actions of Charlotte or the antics of Madeleine, they are beginning to learn ever so gradually how to understand the emotions of others when they are experiencing situations both familiar to them and wildly unfamiliar. Literature challenges all of these children to examine what they already know, so as to understand a narrative that often as not takes them beyond the bounds of that very knowledge base. They begin to imagine what it is like to be another person, what it is like to live in another place, what it feels like to be brave or brilliant, or full of compassion. Such imaginings may be the most important, invisible fruits of literacy whose personal and moral outcomes can never be measured.

What's in a Word

Ah, but we get ahead of ourselves. We aren't finished depicting our own story of the rewards of the simple act of reading to your child! The young child who is engaging with print, even if only *eating it* at the start, is not only gaining new concepts about oral language and theory of mind, but also about what *written* language is. The sheer quantity of possible exposures to print in literate homes means that the young child will experience print in multiple ways, particularly what is called *environmental print*, which includes labels on products, print on toys, signs, etc. Just think about all the letters you see in any given day. Young children see those letters, too. There are printed words everywhere around them. But do young children

actually learn anything from environmental print? When do they begin to notice shapes and images of often seen letter patterns and remember them as familiar objects?

Increasing anecdotal evidence suggests that children from 20 months of age on can do just that as they begin to recognize various forms of environmental print. For example, a child of two often recognizes that the car stops (more or less!) whenever it approaches the archetypal red stop sign. Another child knows every cereal box label by heart. Another child we both know could distinguish between and among the all too various forms of Swiss chocolate and gummi bear wrappers. By the age of three, preliterate children readily engage in a form of "pre-reading" which involves matching a verbal label to the symbol associated with it. When children see the golden arches, they know that this symbol stands for McDonald's. Further, the child can probably name McDonald's in response to seeing the word on a sign. To be sure, she probably can't identify the first letter as an 'M", or read a word that starts with *m*, and it is unlikely that she can identify the word *McDonald's* if it occurred in a different context. What is happening is a simple paired associate of a visual symbol and a known concept.

Both authors are very familiar with a three-year old, who is not three anymore, who was so keenly interested in cars that he could name the make and model of any car that passed by, including in Germany the once infamous Trabi. Even on signs, car words like *Mercedes* or *Ford* became instantly associated by him with a particular car with a particular symbol on the trunk and hood. Although he managed to regale many an unsuspecting adult with his seemingly precocious reading ability of almost any car word, he was not reading at all. (Postscript: Twenty years have passed, and he reads quite well as he rides to his first job on his sleek, grey Google bus. He still can identify any car on the road faster than any of us.)

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The reality is that many young children who are frequently read to seem as if they can "read" the words of their favorite book from start to finish. Even if the book is upside down, as Benjamin Evans, the toddler grandson of our friend Barbara, frequently does in the Boston Public Library—to the utter delight of all passers by! They are reciting from memory the stories they have loved, or they are beginning to make even finer associations with the pictures and pages that belong to those remembered words. Although no self-respecting researcher would ever want to pierce the bubble of a parent's justified pride, these children have not begun to read these precious, dog-eared books. Rather, the children may have begun the fascinating phase of what is known as *logographic* reading. Logographic reading is not absent in the world's writing systems, particularly in their origins. The Chinese writing system, in which a symbol stands for an entire word, remains partly logographic (in the last chapter, we described its greater complexity). But when a young child engages in this form of symbol identification, he or she is assigning a label to a stimulus in a very similar way. They are not

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decoding, they are remembering the correct labels, which they can only do within a very particular context.

While probably not a necessary step in the pre-reading stage, there is evidence that children who build a small vocabulary of "logograms" and actively practice that skill gain a helpful scaffold for learning letters. Some research shows that children who can read logograms and other types of environmental print are more likely to be advanced readers between the ages of four and seven.[21] A fascinating study by Victoria Molfese[22] found that low-income four-year-olds who were taught a variety of print concepts—including logos and other environmental print symbols—were more likely to be proficient at reading actual letters six months later.

Why this might be the case lies in two major cognitive leaps that a young child has to achieve in this early prestage of learning to read. The first cognitive epiphany—understanding symbolic reference—is no small task, but its origins begin very early and quickly become more and more sophisticated. Imagine for a moment asking a seven-month-old boy if he wants a cookie. Next imagine asking this when there is no cookie in the room. The concept implicit in matching a word to a particular object in a space full of objects is hard enough for an infant, but the reality is that by ten to twelve months most of them have learned to do this when the object—particularly, to be sure, a very desirable cookie—is not present.

With environmental print and the many cultural logograms, we are extending this form of cognitive achievement a step further. We are asking children to comprehend that a random visual symbol refers to a seemingly unrelated, typically not physically present, concept. These are all examples of children learning to understand various types of symbols, a necessary precursor to the more sophisticated understanding of the relationship between a single phoneme and the motley lines of a letter symbol meant to represent it.

What's in a Letter

It is no small set of intellectual feats that prepares them and brings us to the second, preparatory cognitive epiphany that involves vision and memory, among other important things. To enter

the first stages of learning to read, a child must build up a visual inventory of the alphabet's arbitrary letter forms and consolidate them in memory. But there is a trick to be learned in many a writing system that goes counterintuitively to what children have learned up to this point. Before they learn letters, most children have learned that objects in their world are the same whether they are upside down or turned around or inverted in any direction. A chair is a chair, and a cup is a cup from whatever direction you gaze upon it. This is the assumption of *mirror invariance*, an ingenious adaptation in the visual system which allows the brain to understand that an object is the same from every direction.

With letters comes a curve ball. Children must, for all purposes, override their original basic assumption and learn that letters are NOT the same if you turn them in different directions. Children have to learn that flipping a letter can make it an entirely new letter. Flip a 'b' around and it is not a funny looking 'b', it is now a 'd'. An upside down "M" can become a "W". This is not simple when you have been operating to that point with a different cognitive rule.

'Mirror invariance' is standard hardware in the visual system of any individual, young or old, both *before* they learn to read and also when they are not literate. When individuals become literate, they actually lose their former rapidity in identifying objects which are mirror images of one another. We do not lose the ability entirely, we just take more time performing the identification accurately. This result is true not only for strings of letters, as one would expect, but also for pictures of objects.

Part of the explanation has to do with a qualitative change in the visual attentional systems with regard to the left-right orientation and top-down orientation of letters. With more exposure and practice, children come to the conclusion that orientation is important; and further, that it can help distinguish between the identity of two similar letters. Keep in mind that for many letters, orientation is irrelevant: for example, the lower case letters *i, o, l, t,* or *m*. For another group of letters the orientation of the letter ensures it is accepted as "correct", but does not create a confusion with another letter: for example, the lower case letters *s, f, r,* or *z*. We are left with a subset of letters where the orientation of the letter determines

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the identity of the letter between two candidates: the lower case letters *p*, *b*, and *d*. Predictably, these reversible letters create the most confusion for all children and at times have served as a red flag by parents and teachers who are watching for signs of a reading disability. The unfortunate misperception that "dyslexics" can be diagnosed on the basis of letter reversals is fed by the fact that children at risk for a reading disability tend to require a bit longer to master this latter class of more confusing letter forms. There is a fascinating hypothesis why. Neuroscientist Stanislas Dehaene[23] suggests that this phenomenon is not a sign of weakness, but rather of the strength of the right hemisphere in dyslexia which insists on seeing "all sides" of the letters!

What's in the Visual Cortex

Dehaene and his colleague Laurent Cohen and others in the cognitive neurosciences have also found that a very particular part of the brain is involved in connecting the visual processes to letters and words when learning to read at any age and in any language. They refer to this area colloquially as the "Letter box" or *visual word form area (VWFA)*, but more formally neuroscientists would label it the ventral occipitotemporal cortex. It is located a little behind the ear area for most people, and will be discussed more thoroughly in the next chapter.

This area has been found to be crucial for the recognition of letters and groups of letters, and even words. In young children who have not yet learned to read, only a few hours of playing a letter learning game called *Graphogame*, by the Finnish research group led by Heiki Lytinnen, caused that area of the brain to become activated.[24] In some children with dyslexia, it is the lack of activation in this area of the brain that is a key identifying feature. Very importantly, this area becomes more responsive when these same children improve their reading abilities. In recent research by Dehaene and colleagues[25] comparing adults with varying abilities in reading, increases in activation in the VWFA were associated with more sophisticated reading skills. Other researchers have found that the VWFA is activated with alphabetic and non-alphabetic languages alike.[26]

One of the most revolutionary findings from Dehaene's group's research[27] involves investigations into the function of the VWFA before literacy is acquired or when someone does not learn how to read. His group has performed fMRI experiments on young children who have not yet learned to read, and also with adults who either never learned to read or became literate later in life. It appears that the VWFA is an important part of the visual system's ability to make *invariant visual object recognition.* Briefly, this term refers to our ability to quickly identify objects that tend to have very consistent features, like faces. When Dehaene's group showed their subjects who could not read a variety of different pictures, the VWFA became activated when the subject saw faces or objects. As the subject became a better reader and they were tested again and shown pictures of faces, the VWFA area no longer showed activation on the left side, but rather on the right side. In other words, when the brain begins to create a circuit in which we store visual information about letters, it appears to reorganize its prior circuitry, particularly for faces. Moreover, his group found that the more facile an individual is at this reorganization, the more likely they are to be a skilled reader.

> The reality is that this simple fact of being read to in a literate environment makes all the difference between growing up in a world that expands with every read book, and one that does not between a developing brain that is beginning to represent all manner of new information about words and letters, and one that does not.

There are several important implications of this work. First, it is an illustration of how literacy literally rewires the brain. Second, it suggests that some forms of reading impairments may have little or nothing to do with weaknesses in the phonological system, but are rather due to difficulties reorganizing the visual recognition system. Finally, it is always encouraging to see that this rewiring can occur beyond childhood, which we translate into "you are truly never too old" to learn to read!

What Is not in a Word, a Letter, or the Visual Cortex for the Non-Literate Person

The latter statement brings us back to the reality faced by the many children and adults who have not become literate. Any study of the cognitive, social, and linguistic differences between children who become literate and those who do not is fraught with multiple difficulties. First, it is extremely difficult to find a population of children with no access to school or with no opportunity to be taught how to read who do not also experience the confounding effects of poverty, malnutrition, instability, or even war. How does one tease apart these dramatic influences on the neurological, social, and cognitive development of the individual from the effects of learning how to read?

Despite these intrinsic problems, a number of important studies have been conducted that were able to isolate and study those variables. Perhaps unsurprisingly by now, the overall findings of these studies demonstrate that learning how to read adds crucial cognitive and linguistic skills to the repertoire of a developing child. A group of researchers from Florida and Guadilajara compared a group of children between the ages of 6 and 13 from the urban areas of Guadalajara and Tijuana, Mexico.[28] Half of the children were literate and attended school, and half were not literate and had never attended school. The children were tested on a range of neuropsychological and linguistic skills: such as, spatial skills, memory, attention, vocabulary, calculation skills, and phoneme awareness. One might hypothesize that the literate children would outperform the non-literate children on every educational measure, but that was not the case. The non-literate children outperformed the literate group on a measure of calculation skills, which sug-

gests that some mathematical skills are able to be learned through experiences outside of schools.

The remaining results were the more predictable ones: In every domain outside of calculation, the literate group outperformed the non-literate group. Children who knew how to read were more efficient at performing tasks that assessed memory, spatial abilities, and sound perception. The results of one task of construction ability were nevertheless surprising, since a well-known finding among non-literate aboriginal children shows a clear advantage for spatial memory tasks. This study's children were assessed on a different spatial-related ability to copy a figure using toothpicks. The literate children were faster and more accurate completing their figures. Taken in isolation, it might seem odd that learning to read would change how a child puts together a figure. However, if Dehaene's work concerning the reorganization of the visual system is considered, one could hypothesize that a brain that can rapidly and accurately identify the small features of letters has also become faster and more accurate identifying the small details of other types of figures. This is yet to be replicated, but is thought-provoking.

Far and away the most important results for the goals of this book, however, concerned the dramatic change in the language skills of the tested literate children. On a test of what is called verbal fluency, children were asked to name as many words as they can think of in 60 seconds that either begin with a certain sound ("*Name as many words as you can think of that start with the "s" sound*) or that belong to a certain category ("*Name as many food words as you can think of"*). These tests do not measure linguistic sophistication there are no extra points for the quality of words or for naming more "literary" words. The simple, harsh reality was that children who never learned to read struggled terribly with this task, especially when asked to name words that start with a particular sound.

To be sure, there has been some debate around this study as to whether the *food* category which was chosen would advantage literate individuals over non-literate. Another common category for this task, for example, is "animals". Would that have been a better choice? Although it might seem that animals represent a universally easier semantic category across populations, such a thought reveals

how unaware we may be of the influence that reading about bears, dinosaurs, lions, or sea lions—animals we would not normally see unless we live near their habitat—has on the range of words that children can recall rapidly. Literacy changes the quality *and* quantity of our everyday experiences with words and, in the process, changes the number and kinds of words the literate person knows well and can retrieve quickly across most common categories. It changes the representations of words in the child's brain.

We want, however, to look for one moment at some of the less studied, positive dimensions of social and cognitive development in a group of preliterate and nonliterate children. Yomi Ogunnaike, a former PhD student of ours and a professor now at the University of Wisconsin-Stevens Point, wrote her dissertation on the implications of the unique cognitive demands placed on three- and four-year-old children growing up in the Yoruba sections of Nigeria[29], where literacy is not a given. When we say unique, it is without exaggeration. Unlike most Western cultures, Yoruba culture demands very specific behaviors in young children. For example, preschool aged children are expected to help their mother around the home or in small merchant-based businesses, and to "run" errands to stores at ages that would be fodder for visits from the department of social services in Western lands. By contrast, Professor Ogunnaike described not only the special emphases that the Yoruba culture places on responsibility, helpfulness, and expectations around chores for even the youngest children, but also the relationship these responsibilities have on the increased cognitive and social development of the children. Her positive findings of these relationships gave us all pause in our western-centric views of what childhood should and should not be like.

What Professor Ogunnaike also found, however, reinforced one of the key leitmotivs in our work on global literacy. When the mothers of the children in the study were literate in the home language of Yoruba, there were significantly more educational, print-based materials in the home. Further, these mothers read regularly to their children, something which mothers who were not literate could not do. It is such a simple, seemingly obvious finding that it might have gone overlooked. The reality is that this simple fact of being read to in a literate environment makes all the difference between

growing up in a world that expands with every read book, and one that does not, between a developing brain that is beginning to represent all manner of new information about words and letters, and one that does not.

The findings with these literate and non-literate children have been replicated in a number of studies with adults, particularly those measuring the phonemic awareness of literate and non-literate adults. As described in Chapter 2, phoneme awareness provides one half of the foundation for understanding and using an alphabetic system of letters, which requires the reader to assign a particular sound to a particular graphic symbol. Several studies which compared non-literate and literate adults found evidence for the notion that non-literate adults struggle with tasks that ask them to show any distinct awareness of a particular sound in their language or speech. Some of these tasks might ask a subject to count the sounds in a word (*How many sounds are in the word "cat"*?), or to leave a particular sound out of a word and tell the examiner what word is left (*Say "floor" without the /l/sound.*). Some tasks may simply ask the subject to repeat a pseudoword (*Say the word "marp"*).

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Almost all the studies conducted have found that literate adults outperform non-literate adults on multiple dimensions of language knowledge, but particularly phoneme awareness tasks like the ones just described. These tasks are not just about sound-knowledge, they measure a person's "metalinguistic" awareness, the ability to examine or reflect about some aspect of language. Such a capacity is evident even in children who have read for only a short period of time, yet this reflective capacity about words proves time and again difficult for people who have not learned to read.

The First "Revolution in the Brain"

A series of studies by neuroscientists Alexandre Castro-Caldas and Alexandra Reis[30] illustrate what they call the "revolution in the brain" that occurs when a person learns a system of letters. In order to study how learning to read changes language processes in the brain, as opposed to how a brain processes language that never has had the opportunity to become literate, these researchers investigated a very unusual population sample. They were able to study siblings who share most of the same factors in their home environment and upbringing with one exception: learning to read. In Portugal, a common and traditional practice until fairly recently was that firstborn children did not attend school, but rather helped at home and took care of their younger siblings who *did* learn to read. Castro-Caldas and Reis studied these siblings when they were approximately 65 years of age with both males and females represented. Their unusual studies confirmed what has been found in the more typical comparisons of literate and non-literate children. Non-literate adults have difficulties with the metalinguistic aspects of language, particularly concerning the sound system. The non-literate siblings were less able to repeat non-words or to identify the initial sounds of their words. Most pertinent to other findings about the ways literacy rewires us, the differences in the literate individuals were reflected in the activation of additional language-based structures of the brain that were not activated in their siblings.

The upshot is that literate adults activate areas when they process language that were not activated before they were literate. Ongoing research by James Booth[31] and other neuroscientists indicates that literacy makes new connections between language and visual atten-

tion systems that were never there before. These authors illustrate that learning how to read is not a simple addition of an extra circuit in the brain, but rather represents a new, expanded set of networks and a new organization of connections for language itself.

We would like to provide a small, illustrative, anecdotal finding in our own work that has never been published, because the sample of children we studied was too small. With the generous help of our MIT colleague, John Gabrieli and his team, one of our PhD students at the time, Elizabeth Norton, imaged children with dyslexia before and after they began our RAVE-O reading intervention program. Because they could not read initially, the children were simply asked to *listen* to words that rhymed, while they were in the fMRI magnet at MIT. The results still make us happy, however small a number of children we tested. Before they learned to read, typical areas for auditory and language processing were activated. After they learned to read, however, not only were those areas activated, but areas in the *visual cortex were also activated*. In other words, even when they only listened to words, the acquisition of reading had made these newly literate children automatically "see" the "heard" words. These familiar words had now become *represented* in their visual networks, which we'll discuss in the next chapter. It is another example of how reading "rewires" our brains. It is also an example of the critical importance of *all the exposures* to the sounds and visual patterns of letters and words that children receive. One of the most important lessons in the differences between literate and non-literate environments is that the more exposures children have to all the aspects of language and print we have been discussing, the better "represented" this information becomes in the literate child's brain. Every letter, every phoneme, every word "adds" to the elaboration of the developing brain circuit.

Literacy and Child's Play

Literacy is, however, not only about changes in language and the brain! We would like to bring to the fore a difference in the effect of literacy on children's play, which is, as our colleague George Scarlett beautifully expounds[32], one of the most important ways children learn about the many aspects of their world. Although many

developmental researchers have discussed this domain of play and literacy, we want to describe something just a little different about the relationship between print and play. It is based on the observations of the second author during site visits she has made recently in our work in global literacy in places like the slums of Kampala and the villages of India. It begins with the fact that the experiences of a child from birth to three in a literate world differ not just because of socioeconomic forces, but they differ radically because of the exposure to the myriad objects, spaces, signs, and experiences that children learn about in an everyday literate environment.

Most of us never think about it, but the entire *Weltanschauung* of a child in a literate home is dominated by early and many manifestations of the symbolic world. Before some children are even born, there are baby book showers! (Which we personally think a wonderful concept.) From the first year onward, there is a panoply of alphabet blocks, board books, letter puzzles scattered about, all of which expose children to the forms of letters, sometimes the names of those letters, and often the *bright colors of childhood* in those letters and books. Everywhere there are vividly colored items and sometimes even specially designated spaces covered with print. The very vibrancy and various shapes of the toys, the books, and the special child-centered places all give expression to the idea that there is a space where children are safe and where they can go to learn about their world and the mysterious, but intriguing symbols it contains. The German philosopher Walter Benjamin wrote several less known essays about how the colors of childhood play a particular role in the origins of human consciousness[33], and we believe he could not be more perceptive in his insights.

In stark contrast are the worlds of children raised in environments without toys or books or spaces that are set apart by the colors of an innocent time. These children are found, to be sure, in underdeveloped countries around our world. But we wish to emphasize that they live everywhere, as study after study in rural United States and urban slums in developed countries document.[34] These children are not only missing the special cognitive-affective-social experiences of interacting with beloved persons around print and books, but they are also missing one of the most beautiful types of play that exist. They are missing the formation of friends

that last a lifetime: Curious George, Christopher Robin, Tigger and Pooh, Charlotte and Wilbur. They are not only missing the special vocabulary of books, they are missing the language of *play* and all the friends that accompany it.

Finally, with none of the subtle communicative messages that these color, spaces, and environmental print convey, they are sometimes missing something more still: the safe haven of childhood. On a recent visit to a preschool in Uganda, the second author was struck by the presence in every classroom of black and white and grey posters with pictures of "Dangerous Objects". Posters of barbed wire and razor blades, not bears and runaway bunnies, dominated the room. While every parent remembers the challenge of teaching their children to avoid electrical outlets and stoves, imagine this challenge in an environment where the notion of children's spaces and toys does not exist, but dangerous objects do and in abundance. The point of this example is not to make a plea for more toys and playgrounds in Kampala, although that would be a desirable outcome. Rather, this example is meant to illustrate in a small way, how the world of language and literacy is created from the very first day of a child's life in a literate home—on the walls, from the ceiling, on the floor, beside the bed, and under the tables—and how different these beginnings are for children who have no exposure to this world.

The simple introduction of letters and books and stories changes the world of childhood. To be sure, it ups the symbolic and cognitive ante, but it simultaneously exposes the children to emotional experiences and narratives they might never otherwise have. And for some children, such experiences are their personal vehicles that transport them away from wherever they are and give them reason to aspire and contribute what they know.

Literacy is the one safe haven a child can have in almost any culture. It is a form of play that can happen even when the grounds nearby are littered with dangerous objects. It is a form of play that, as Proust described years ago, can exist like magic "in the midst of solitude" or in the middle of a slum or under the covers with a flashlight.

And now, we turn the clock ahead. We want to use the lessons here about the child's developing circuit to examine the reader's

own reading brain. The surprises to be found in the development of literacy are not only for kids.

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