The Power of Early Experiences

Our brains shape and reshape themselves in ways that depend on what we use them for throughout our lives. Learning language is a nice example of how experiences contribute to each person's unique pattern of brain development. The ability to speak and to understand other's speech requires only the minimal opportunity to communicate that almost all children experience. However, *which* language a child learns to speak depends on the language he experiences, and his brain will adapt to this specific language. When an infant is 3 months old, his brain can distinguish several hundred different spoken sounds, many more than are present in his native language. Over the next several months, however, his brain will organize itself more efficiently so that it only recognizes those spoken sounds that are part of the language that he regularly hears. For example, a one-year-old Japanese baby will not recognize that "la" is different from "ra," because the former sound is never used in his language. During early childhood, the brain retains the ability to re-learn sounds it has discarded, so young children typically learn new languages easily and without an accent. After about age 10, however, plasticity for this function is greatly diminished; therefore, most people find it difficult to learn to speak a foreign language as well as a native speaker if they only begin to learn it in adolescence or adulthood.

More importantly, early experiences can determine how proficient a child becomes in his or her native language. Researchers found that when mothers frequently spoke to their infants, their children learned almost 300 more words by age 2 than did their peers whose mothers rarely spoke to them (Huttenlocher et al., 1991; also, Hart & Risley, 1995). Furthermore, studies have suggested that mere exposure to language such as listening to the television or to adults talking amongst themselves provides little benefit. Rather infants need to interact directly with other human beings, to hear people talking about what they are seeing and experiencing, in order for them to develop optimal language skills. Unfortunately, many parents are under the mistaken impression that talking to babies is not very important because they are too young to understand what is being said.

A new consensus is emerging about the importance of intervening with families of disadvantaged children in the first months and years of life to ensure they provide the kinds of experiences that support optimal development. Psychologists have long known that children of poorly educated, low-income parents often don't reach the same intellectual levels as children of well-educated, wealthy parents. The recent developments in brain research have provided new insights into why this is so. Parents who are preoccupied with a daily struggle to ensure that their children have enough to eat and are safe from harm may not have the resources, information, or time they need to provide the stimulating experiences that foster optimal brain development. Infants and children who are rarely spoken to, who are exposed to few toys, and who have little opportunity to explore and experiment with their environment may fail to fully develop the neural connections and pathways that facilitate later learning. Despite their normal genetic endowment, these children are at a significant intellectual disadvantage and are likely to require costly special education or other remedial services when they enter school. Fortunately, intervention programs that start working with children and their families at birth or even prenatally can help prevent this tragic loss of potential (*see box below*).

Understanding How the Brain Develops

To understand how this happens, we need to understand a bit about how the brain works. The brain is comprised of many regions that perform specific functions, such as identifying what we see, processing spoken language, or assessing whether we are in danger. Within each of these brain areas are millions of neurons, or nerve cells, which send messages to each other across synapses. These trillions of nerves and synapses and the pathways they form make up the "wiring" of the brain; they allow all of the various areas to communicate and function together in a coordinated way. The number and organization of connections in the brain influence everything from the ability to recognize letters of the alphabet to facility at managing complex social relationships.

In most regions of the brain, no new neurons are formed after birth. Instead, brain development consists of an ongoing process of wiring and re-wiring the connections among neurons. New synapses between cells are constantly being formed, while others are broken or pruned away. This happens throughout life. However, in early childhood the brain is genetically programmed to produce more synapses than it will ultimately use. Indeed, by 8 months of age a baby may have an astounding 1,000 trillion synapses in his brain! This blooming of synapses happens at different times in different areas of the brain. Development then proceeds by keeping the synapses that are used and pruning away those that aren't. The pruning of synapses happens over the childhood years as the different areas of the brain develop(Huttenlocher & Dabholkar, 1997).

Pruning allows the brain to keep the connections that have a purpose, while eliminating those that aren't doing anything. In short, pruning increases the efficiency with which the brain can do what it needs to do. But, because the brain operates on the "use it or lose it" rule, an "over-pruning" of these connections can occur when a child is deprived of normally expected experiences in the early years. This leaves the child struggling to do what would have come more naturally otherwise.

Some areas of the brain, such as those which help us see clearly, become less "plastic" or changeable when the pruning is over. This has led to tremendous concern about providing what the brain needs to prune and organize itself correctly before the "windows of opportunity" close. For example, surgeons now remove congenital cataracts as early in infancy as possible, because they know that if they wait until the child is older, the neural connections between his eyes and his brain will fail to develop properly, and he will never be able to see. Brain scientists are also working diligently to unlock the secrets of how the brain turns on and off its ability to change itself. There is real hope that if we can understand the ways this happens, we can create therapies, both those that use drugs and those that use carefully structured experiences and training exercises, that can open up windows and re-wire brains that were deprived of normally expected experiences early in life or those that get damaged later in life.