# Brain research and its influence on language development and acquisition essay

Design, Architecture

Brain Research and its Influence on Language Development and Acquisition

Language acquisition is one of the most fundamental human traits, and it is obviously the brain that undergoes the developmental changes (Sakai, 2005, p. 815-819). During the years of language acquisition, the brain not only stores linguistic information but also adapts to the grammatical regularities of language. Recent advances in functional neuro-imaging have substantially contributed to systems-level analyses of brain development (Sakai, 2005, p. 815-819). Perhaps no aspect of child development is so miraculous and transformative as the development of a child's brain (Brotherson, 2005).

Brain development allows a child to develop the abilities to crawl, speak, eat, laugh and walk. Healthy development of a child's brain is built on the small moments that parents and caregivers experience as they interact with a child (Brotherson, 2005). A number of factors influence early brain development. These important factors include genetics, food and nutrition, responsiveness of parents, daily experiences, physical activity and love. In particular, parents should be aware of the importance of furnishing a healthy and nutritious diet, giving love and nurturing, providing interesting and varied everyday experiences, and giving children positive and sensitive feedback (Brotherson, 2005). In the past, some scientists thought the brain's development was determined genetically and brain growth followed a biologically predetermined path. Now we know that early experiences impact the development of the brain and influence the specific way in which the circuits (or pathways) of the brain become " wired.

A baby’s brain is a work in progress, the outside world shapes its development through experiences that a child’s senses absorb (Brotherson, 2005). Experiences that the five senses take in help build the connections that guide brain development. Early experiences have a decisive impact on the actual architecture of the brain. Recent equipment and technological advances have allowed scientists to see the brain working (Brotherson, 2005).

What scientists have found is that the brain continues to form after birth based on experiences. An infant’s mind is primed for learning, but it needs early experiences to wire the neural circuits of the brain that facilitate learning (Brotherson, 2005). It has long been known that different regions of the brain have specialized functions.

For example, the frontal lobes are involved in abstract reasoning and planning, while the posterior lobes are involved in vision. Until recently, it was believed that these specialized regions developed from a genetic blueprint that determined the structure and function of specific areas of the brain (Genesee, 2000). That is, particular areas of the brain were designed for processing certain kinds of information from birth.

New evidence suggests that the brain is much more malleable than previously thought. Recent findings indicate that the specialized functions of specific regions of the brain are not fixed at birth but are shaped by experience and learning (Genesee, 2000). To use a computer analogy, we now think that the young brain is like a computer with incredibly sophisticated hardwiring, but no software. The software of the brain, like the software of desktop computers, harnesses the exceptional processing capacity of the brain in the service of specialized functions, like vision, smell, and language. All individuals have to acquire or develop their own software in order to harness the processing power of the brain with which they are born (Genesee, 2000). There are “ windows of opportunity,” or critical periods in a child’s life when the brain is biologically best equipped to learn language. Each child has more than fifty thousand nerve pathways that can carry sounds from the human voice from the ears to the brain.

The brain encodes the words and actually rearranges its brain cells into connections or networks to produce language (Fleming, Family Life Specialist, 2002). Brain research clearly indicates that language development must be fostered early in children or be impaired or lost. If a child hears little or no human sound, the brain waits in vain and eventually will “ retire” these cells from this function and give these cells a different function.

By age ten, if the child has not heard spoken works, the ability to learn spoken language is lost (Fleming, Family Life Specialist, 2002). In an Indiana study, implants used in young deaf children o introduce human sound actually changed the brain structure so that these youth could begin constructing a vocabulary. The “ use it or lose it” principle applies to the brain and language development (Fleming, Family Life Specialist, 2002). A University of Chicago study showed that babies whose mothers talked to them more had a bigger vocabulary. By twenty four months, the infants of less talkative mothers knew three hundred fewer words than babies whose mothers spoke to them frequently (Fleming, Family Life Specialist, 2002). Babies are “ listeners” and spoken language reinforces brain connections, which encourage more language development.

Another study that scanned brain activity of children revealed that between the ages of four and twelve an enormous amount of brain restructuring takes place (Fleming, Family Life Specialist, 2002). Depending on a child’s experiences, the brain is deciding whether to keep or eliminate connection. If the child is receiving rich, sensory stimulation, a surge of learning takes place (Fleming, Family Life Specialist, 2002). The understanding that the brain has areas of specialization has brought with it the tendency to teach in ways that reflect these specialized functions. For example, research concerning the specialized functions of the left and right hemispheres has led to left and right hemisphere teaching. Recent research suggests that such an approach does not reflect how the brain learns, or how it functions once learning has occurred. On the contrary, “ in higher vertebrates (humans), brain systems interact together as a whole brain with the external world” (Genesee, 2000). Learning by the brain is about making connections within the brain and between the brain and the outside world.

Until recently, the idea that the neural basis for learning resided in connections between neurons remained speculation. Now, there is direct evidence that when learning occurs, neuro-chemical communication between neurons is facilitated, and less input is required to activate established connections over time (Genesee, 2000). New evidence also indicates that learning creates connections between not only adjacent neurons but also between distant neurons, and that connections are made from simple circuits to complex ones and from complex circuits to simple ones. For example, exposure to unfamiliar speech sounds is initially registered by the brain as undifferentiated neural activity. Neural activity is diffuse, because the brain has not learned the acoustic patterns that distinguish one sound from another (Genesee, 2000). As exposure continues, the listener (and the brain) learns to differentiate among different sounds and even among short sequences of sounds that correspond to words or parts of words. Neural connections that reflect this learning process are formed in the auditory (temporal) cortex of the left hemisphere for most individuals. With further exposure, both the simple and complex circuits (corresponding to simple sounds and sequences of sounds) are activated at virtually the same time and more easily (Genesee, 2000).

As connections are formed among adjacent neurons to form circuits, connections also begin to form with neurons in other regions of the brain that are associated with visual, tactile, and even olfactory information related to the sound of the word. These connections give the sound of the word meaning. Some of the brain sites for these other neurons are far from the neural circuits that correspond to the component sounds of the words; they include sites in other areas of the left hemisphere and even sites in the right hemisphere (Genesee, 2000). The whole complex of interconnected neurons that are activated by the word is called a neural network. The flow of neural activity is not unidirectional, from simple to complex; it also goes from complex to simple. For example, higher order neural circuits that are activated by contextual information associated with the word doggie can prime the lower order circuit associated with the sound doggie with the result that the word doggie can be retrieved with little direct input (Genesee, 2000). Complex circuits can be activated at the same time as simple circuits, because the brain is receiving input from multiple external sources auditory, visual, spatial, and motor. At the same time that the auditory circuit for the word doggie is activated, the visual circuit associated with the sight of a dog is also activated.

Simultaneous activation of circuits in different areas of the brain is called parallel processing (Genesee, 2000). In early stages of learning, neural circuits are activated piecemeal, incompletely, and weakly. It is like getting a glimpse of a partially exposed and very blurry photo. With more experience, practice, and exposure, the picture becomes clearer and more detailed (Genesee, 2000).

As exposure is repeated, less input is needed to activate the entire network. With time, activation and recognition are relatively automatic, and the learner can direct her attention to other arts of the task. This also explains why learning takes time. Time is needed to establish new neural networks and connections between networks. This suggests that the neural mechanism for learning is essentially the same as the products of learning, learning is a process that establishes new connections among networks and the new skills or knowledge that are learned are neural circuits and networks (Genesee, 2000).

So we need to ask ourselves “ what are the implications of these findings for teaching? First, effective teaching should include a focus on both parts and wholes. Instructional approaches that advocate teaching parts and not wholes or wholes and not parts are misguided, because the brain naturally links local neural activity to circuits that are related to different experiential domains (Genesee, 2000). For example, in initial reading instruction, teaching phonics independently of the meaning of the words and their meaningful use is likely to be less effective than teaching both in parallel. Relating the mechanics of spelling to students’ meaningful use of written language to express themselves during diary writing, for example, provides important motivational incentives for learning to read and write (Genesee, 2000). Second, and related to the preceding point, teaching (and learning) can proceed from the bottom up (simple to complex) and from the top down (complex to simple). Arguments for teaching simple skills in isolation assume that learners can only initially handle simple information and that the use of simple skills in more complex ways should proceed slowly and progressively (Genesee, 2000).

Brain research indicates that higher order brain centers that process complex, abstract information can activate and interact with lower order centers, as well as vice versa. For example, teaching students simple emotional expressions (vocabulary and idioms) can take place in the context of talking about different emotions and what situations elicit different emotions (Genesee, 2000). Students’ vocabulary acquisition can be enhanced when it is embedded in real-world complex contexts that are familiar to them. Third, students need time and experience (“ practice”) to consolidate new skills and knowledge to become fluent and articulated (Genesee, 2000). Brains are not all the same. Take the early research on left-right hemispheric differences with respect to language. For most individuals, the left hemisphere is critically involved in most normal language functions.

We know this because damage to the left hemisphere in adults leads to language impairment, which is often permanent. However, approximately 10% of normal right-handed individuals have a different pattern of lateralization; their right hemispheres or both hemispheres play a critical role in language (Genesee, 2000). Males and females have somewhat different patterns of lateralization, with males being more left-hemisphere dominant than females. In the domain of reading, brain maps of students with dyslexia demonstrate that there are very large individual differences in the areas of the brain that underlie their difficulties (Genesee, 2000). We also know that the areas of the brain that are important in specific domains of learning can change over the life span.

There is increasing evidence of right hemisphere involvement in early language learning but less in later learning. Young children with lesions to their right hemisphere demonstrate delays in word comprehension and the use of symbolic and communicative gestures. These problems are not found in adults with right hemisphere lesions. Stiles and Thal have argued that there may be a link between the word comprehension problems of children and the right hemisphere, because “ to understand the meaning of a new word, children have to integrate information from many different sources.

These sources include acoustic input, but they also include visual information, tactile information, memories of the immediately preceding context, emotion sin short, a range of experiences that define the initial meaning of a word and refine that meaning over time" (Genesee, 2000). We know from a variety of sources that integration across domains of experience is a right-hemisphere function. By implication, brain research confirms what we know from education research: that educators must make provisions for individual differences in learning styles by providing alternative grouping arrangements, instructional materials, time frames, and so on.

Instruction for beginning language learners, in particular, should take into account their need for context-rich, meaningful environments. Individual differences in learning style may not be a simple matter of personal preference, but rather of individual differences in the hardwiring of the brain and, thus, beyond individual control (Genesee, 2000). Our understanding of the brain is continually evolving, thus our interpretation of the implications of findings from brain-based research for teaching and learning should also continually evolve. Brain research cannot prescribe what we should teach, how we should organize complex sequences of teaching, nor how we should work with students with special needs (Genesee, 2000).

Educators should not abandon their traditional sources of insight and guidance when it comes to planning effective instruction. They should continue to draw on and develop their own insights about learning based on their classroom experiences and classroom-based research to complement the insights that are emerging from advances in brain research (Genesee,

2000) The development of a child's brain holds the key to the child's future. Although the " first years last forever" in terms of the rapid development of young children's brains, the actual first years of a child's life go by very quickly (Brotherson, 2005). So touch, talk, read, smile, sing, count and play with your children.

It does more than make both of you feel good. It helps a child's brain develop and nourishes the child's potential for a lifetime (Brotherson, 2005). ReferencesBrotherson, S. (2005). Understanding Brasin Development in Young Children. Retrieved from www. ag. ndsu.

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