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# DEVELOPMENT OF LEARNING IN HUMAN BRAIN

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## *ABSTRACT*

*This study considers the learning development in the human brain through different ages in order to understand the specific cognition process at some age's stages. From the first stage when trillions of connections between the neurons of the new child born to the later age, the human being acquires various experiences related to the type of function development of the brain structures, such as the posterior cortical regions and finally anterior regions, the sensory-motor cortex and brain stem, grey matter, and prefrontal and posterior. That beneficial for improving the skills and abilities when human being learns upon males and females. That important to produce an experience of, for instance, thinking, emotion, language processes, able to speak, anxiety, mathematics, logic, and other behavior.*

***KEYWORDS:*** *Neuroscience, Brain, Brain Structure, Brain Function, Development, Age, Learning*

**Abbreviations:** Early Brain Insult (EBI), Ventromedial Prefrontal Cortex (VMPC)

## INTRODUCTION

Since the brain is the directing organ of the entire human body, we must study the brain to interpret what human do and why (Hart, 1981). Hence, the neuroscience studies the organization of nervous systems and their functions to produce behavior (Purves, et al., 2004). Thereby, according to Robertson, Knight, Rafal, and Shimamura, (1993) stated that the contemporary perspective of cognitive neuroscience employs the biological evidence in order to understand the normal cognition. The human brain develops through several periods in a long lifetime and the learning is more rapidly between birth and age five than other age (Edie, & Schmid, 2007). This leads to know the age of specific learning and how to use the brain's functions to develop and improve the skills and abilities when human being learn (Alghafri, 2012).

## THE RELEVANCY BETWEEN BRAIN STRUCTURES AND ITS COGNITIVE FUNCTIONS

The brain includes some of the parts of the brain are located on the left side of the brain and some are the right, while others are on top or bottom as well as at the back and front part of the brain (Alghafri, 2012). The brain controls all body and cognitive activities through the function of each area, such as thinking, memory, emotion, and learning (Society for Neuroscience, 2006). Regard to that the neuroscience studies investigate the major structure of a brain and the central nervous system. That investigation is happening because each part of the brain is responsible for the specific function in the body.

According to the Society for Neuroscience (2006) the forebrain is credited with the functions of thinking, planning, and problem-solving. The memory could be conducted by the hippocampus while the thalamus conceder the coming information into the brain. The neurons of the hypothalamus monitor information coming in from the autonomic

nervous system. Also, the sensory information that comes from sense organs to the brain imparted by two pairs of small hills, colliculi, collections that locate on the upper of the midbrain. However, The respiration and heart controlled by the pons and medulla oblongata that locate in hindbrain where is consisted the cerebellum to control movement and cognitive processes that need precise timing.

In this regard, it should also be noted that the total volume of the brain of male and female become close together in females around age 11 and 15 in males and females respectively (Kolb, & Gibb, 2011). Besides that, if the parents become subjected to nutritional deficiencies and toxic chemicals, or one of them, be causes of learning difficulties (Cai L, Chan J, Yan J. H. & Peng K.; 2014). For example, the National Down Syndrome Society in 2009 found that syndrome down considered the most common genetic cause of some learning difficulties types (Nugent, 2011). Also, if early brain insult (EBI) happened, particularly before the age of 2 years, that impact on the intellectual ability, language, memory, attention and executive function (Anderson, Spencer-Smith, & Wood, 2011). However, there is a possible mechanism underpinning recovery, that is why it is still able to learn, and doing the cognitive processes, as well as their effect on the immature brain (Anderson, Spencer-Smith, & Wood, 2011).

## HUMAN BRAIN DEVELOPMENT

The human born with 100 billion neurons in the brain, approximately, and the development of the brain continues long after birth, with dendrites of some neurons in the neocortex continue to develop after birth as long as the human being grows into old age (Society for Neuroscience, 2006; Upledger, 1999). The brain begins to make trillions of connections between the neurons while the child born (Tayler, Sebastian-Galles, & Bharti, 2007; Wolfe, 2001). Mostly neurons in the brain of the infant are unconnected to each other at the stage of birth, but by age three years become intensive connections. These connections lead for example, to seeing, hearing, smelling, and learning (Carey, 1990). Moreover, the experiences in this stage take place through brain process for developing the brain connections (Halford, 2005) by electrical activity of synapses process (Goswami, 2008) related to increasing of synapse density (Johnson, 2001). A brain does continue to form synapses during the lifetime, in view of the fact that those synapses are important for learning and memory processes (Greenough, Black & Wallace, 1987).

Generally, the young children have rudimentary cognitive abilities. Nevertheless, most cognitive abilities improve steeply in childhood while in adolescence have a slower rate (Tamnes, 2010). By the time the brain grows during the first year, the posterior cortical regions and finally anterior regions come to influence behavior, such as thinking of visual ability and spatial localization (Johnson, 2001), thus the child is able to suck, speak, crawl and walk (Tayler, Sebastian-Galles, & Bharti, 2007) and giving the opportunity for teaching and instruction by adults (Johnson, 2001).

The brain regions became fully connected at age of two while at the age of one month and one year, a child need larger network cost to make brain regions fully connected, hence the brain network's cost efficiency increases as well as the brain development (Halford, 2005) to age 1 year old and 2 years old (Fan, Shi, Smith, Lin, Gilmore, & Shen, 2011). This full connection of region brain is important to produce an experience of learning, thinking (Halford, 2005) and also emotion, especially in a conscious state (Wolfe, 2001).

Human beings are born ready to learn as 85% of their abilities, skills, personality, and intellect are refined by age year five because core brain structure is formed by that age (Edie, & Schmid, 2007). Freud believed that the period 1st year to 5th year of early childhood is important to make the personality of the human being (Fernald, & Fernald, 2004). From

age year two to age at least 20 years, the cortex becomes thinner in a caudal-rostral gradient that correlates with behavioral development and development of some language processes, such as vocabulary (Kolb, & Gibb, 2011).

Related to Adriana van der Plas (2011), the region of the brain that is related to social behavior is the ventromedial prefrontal cortex (VMPC). Between age 4 and 10, the human brain provides an opportunity and ready to learn the social skills by social play through some characteristics like communication and cooperation (Adriana van der Plas, 2011; Poirier, & Smith, 1974).

Accordingly, the studies indicated that by age of two years old, the general manifestation of brain structures is similar to that in adult brain whereas, by age of three years old, most of the fiber tracts can be observed (Johnson, 2003). Therefore, by the age of three, as studies showed, the structure of the brain approximately is almost complete and all the main fiber tracts can be observed (Johnson, 2001).

In the neonate, metabolic activity is important in the sensory-motor cortex and brainstem that to do the reflex functions. From t to 3 months, the visual-spatial integrative function is distinct in the visual and the adjacent parietal cortex which works in with the development of visual-spatial integrative function. From 6 months to a year, metabolic activity, particularly in the frontal cortex which works within the development of higher cortical functions. Some studies of brain function found that the emotional development is between from age one day to two years, mathematics and logic is around the first day of birth to year four and language is between from the beginning of birth to years ten but warbling from about age three year to old ten (de Montfort & Boon, n. d). Also, a study found that by age 3, the aggregate vocabularies learned in professional families approximately 1,116 words; for working-class families it almost 740, and for welfare families nearly 525 (Edie, & Schmid, 2007).

In age 5 years, children can work consciously with two bits of data/information at a time, this effect on the capacity of children memories. Accordingly, pupils progressively achieve better on memory tests while they do not spontaneously produce memory strategies at times until around age 10 years old. For instance, the pupils at about 5th grade, they can efficiently use of memory strategies for storing knowledge and making an experience of learning and thinking way(Wolfe, 2001).

The children brains in the stage of age 5 to 15 years can do the critical/logical thinking and simple mathematical processes. For example, children can increase recalling of the number of digits by one every two years until a mental age of 15 years. In more details, at age 5, children can recall two digits, at age 7, recall is three digits and at age 11, five digits (Wolfe, 2001). That because the logical operations related to the flow of data/information through the connections (Kandel, 2000). More than that, the children between ages 9-11 years old, they are also responded to repeating information such as letters (Casey, Giedd & Thomas, 2000).

Furthermore, studies upon males and females at age 11 years old, revealed that both white and grey matters increase in left inferior frontal gyrus in males brains more than females (Giedd et al., 1999; OECD, 2007). Furthermore, in pre-adolescence, gray matter in the frontal lobe and parietal-lobe reached a maximum volume in males brains at average 12 years while in females at average 10.6 years old (Giedd et al., 1999). Accordingly, the grey matter plays role in higher-order functions as well as in controlling of emotion, which is associated with the development of the brain (OECD, 2007). In ages between 8 to 25 years old, the studies indicated that the modularity of functional brain networks had little changes whereas it higher than the brain network of the old individual (fan, et al, 2011). Other studies uncovered that by growing of

the brain between the ages of 7 and 30 years, the efficiency in cognitive performance is increased due to the limitation of diffusion of prefrontal and posterior (Durston & Casey, 2006). Additionally, in the same stage of this period of ages, the interactions between brain regions are affected by genetic and environmental factors during different human ages, such as 5, 12 and 18 old years as Lenroot and Giedd (2008) found. Also, that regions that are structurally and/or functionally connected, they are influenced by similar genetic factors. For example, the interaction of age with heritability is different due to genetic effects increased with age. This kind of characteristic affects on the magnitude of producing the complex reasoning abilities during the several ages (Halford, 2005; Lenroot & Giedd, 2008).

Lastly, the synaptic density of prefrontal cortex regions gradual decrease into young adulthood, specifically, during late childhood and adolescence (Casey, Giedd & Thomas, 2000). Nevertheless, the cognitive capacities, such as thinking skills, are continued development (Halford, G. S. (2005). Accordingly, the brain begins to eliminate the not strengthening synaptic connections (Casey, Giedd & Thomas, 2000). Hence, the development of thinking skills could be assessed from the early primary years and continues during the education experience (Lawson, 1993). This character assists each individual to be a unique pattern of mind, thought, and emotions.

## CONCLUSIONS

According to Robertson, et al., (1993) the cognitive neuropsychology employs the neuropsychological data to understand the normal cognition. The knowledge of main anatomical terms of the human brain supported the understanding of the location of a particular brain structure (Banich, 2004) and as well supported the discovery of the functions of each brain structure to be aware of the learning and instructional processes and development age of each of them (Goswami, 2004; Katzir & Paré-Blagoev, 2006; Varma, McCandliss, & Schwartz, 2008) that describes how the human being learns by discovering the biological roles of brain and examining which parts of the brain structures are responsible for specific skills and abilities through the various ages. Finally, there are several and different implications for systematic growth cycles of cognition and brain in education. Therefore, it is essential for educators become involved in neurocognitive and neuroscience research to contribute to educational theoretical and practical challenge (Fischer, 2008).

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