Lecture 9:Neuroplasticity

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Neuroplasticity

An interesting phenomena observed in human beings is the ability of the brain to develop compensatory mechanisms in the aftermath of injury. This is referred to as neuroplasticity. What it actually means is that neurons form new connections to allow the person concerned respond to their environment. There are evidences suggesting that in the case of damage to one of the hemispheres the other hemisphere might take over some of its functions. Clinical cases endorse that when cortical areas are stimulated through activities, changes appear at the behavioural level over time. Studies suggest that the brain undergoes physical change due to learning and other experiences. The same mechanism helps those with brain damage to recover functions.

Two mechanisms have been suggested that underlie neuroplasticity in the aftermath of brain injuries — diaschisis and functional reorganization. Diaschisis is a condition of depression of activity at those distant non-damaged sites that are functionally connected to the area of lesion. These areas resume functioning as the areas without lesion gets reconnected to other areas. On the other hand, functional reorganization refers to a compensatory process wherein the neural circuits surviving injury gets reorganized (Luria, 1973).

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Interhemispheric competition is another important factor in this regard. The competitive relationship between the two hemispheres (Kinsbourne, 1993) also explains recovery of functions to certain extent. However, there could also be cases of excessive growth of neurons or excessive release of neurotransmitters. This could lead to spasticity.

It might be interesting for the students of behavioural sciences to understand the factors that contribute to this type of recovery. Although each case is unique in itself, certain factors have imperative influence on the recovery process. Some of them are described below.

Age at the time of brain injury - The effect of brain injury is reportedly high in children and older adults as compared to those in the middle age group. Children have a developing system and severity of the damage to it might not be visible at the early stages of development. However, it might appear at an older stage in terms of developmental delay and unexpected deficits. In the case of older adults, compensation of the acquired deficit becomes more difficult. For the psychological viewpoint, preinjury intelligence and educational levels are major predictors of degree of function recovery (Brooks & McKinlay, 1987). The diverse cognitive requirements coupled with educational activities might increase neural connectivity. For instance, level of education and amount of dendritic branching in Wernicke's area are positively related (Jacobs, Schall, & Scheibel, 1993).

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Gender - There is research findings pertaining to possible gender effect on recovery of functions. For example, Kimura (1983) found better recovery in females after left-hemisphere lesions than in males. This was based on the examination of 224 aphasia (impaired language ability) and apraxia (inability to perform a purposeful body movement) patients with single left hemispheric lesions. Notably speech and apraxia in females often arose from damage to anterior part of the left hemisphere rather than from the posterior region. This was not true for males. Further, progesterone is instrumental in the enhancement of neuronal outgrowth, formation of new myelin sheaths, and regulation of GABA (gama-aminobutyric acid) receptors.

Time since injury and severity - The rate of recovery is initially fastest and usually decreases over time. It has been observed that in cases of moderate to severe injury, recovery is faster during the first six months and then slower over the next two years. Thereafter, spontaneous recovery becomes slower. Severity of the injury is very important for recovery inasmuch as those with mild injuries typically recover faster as compared to those with severe injuries.

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Significance of understanding human nervous system for psychology

Overall, the understanding of human nervous system helps us relate it with behavioural manifestations, thus enriching our knowledge about human behaviour. It is not possible to de-link human behaviour from physiological control and regulatory mechanisms. Let us take two most commonly talked about topics in psychology— colour naming and Müller-Lyer illusion. We all know that there are cultural differences in naming certain colours. Some languages spoken in cultures near to the equator fail naming colours at the blue end of the spectrum such that green and blue, blue and black, or green, blue and black are not given different names. Interestingly, if you look at it from bio-behavioural perspective, this difference is based on physiological difference in colour vision. Physiologically, the people living near to the equator have increased interocular yellow pigmentation and this leads to decreased sensitivity for the blue end of the spectrum.

Let us look at the Müller-Lyer illusion wherein the length of feather-headed line is overestimated as compared to the length of arrow-headed line. An explanation for such illusion is interocular pigmentation. It has been observed that the increase in interocular pigmentation leads to decreased image contrast on the retina. This generates more veridical perception of the figure eliciting illusion. Similarly there are many more examples endorsing the importance of understanding human behaviour from a bio-behavioural perspective.

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