

Theme: Diffusion and Consciousness.

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Cristóbal Carnero Pardo: **Brain and Cognitive Reserve.**

It is assumed that neurogenerative diseases, Alzheimer disease being the most frequent and known example, **are the major challenge that face modern societies in terms of social-health.** Whether medicine-based or not, any measurement that can delay the initiation of these diseases will have a great positive impact on costs and consequences. Up to now, regrettably, no medicine is available that has shown this favourable effect although medicines exist that indeed create a relief from the symptoms.

Many studies have proved that the Alzheimer disease and other neurogenerative diseases start years before the first symptoms appear. This means that there are people who are suffering the processes although showing no clinical signs of the disease. They can even die due to other problems and without ever presenting any symptoms. A series of studies (revised by Bennet DA et al 2006(1)) have shown that one of every three individuals older than 80 years, and who have passed away, have injuries in their brain which are typical of the Alzheimer disease although they had not shown any symptoms of the disease during their lifetime.

This ability of the brain to endure an injury up to a certain scale without presenting symptoms is now called “Reserve”. The study, due to its nature and the determinant factors, has become of great scientific and social interest. Capacity increase, if possible, will translate into a delay of clinical indications of these neurogenerative processes and consequently cause a parallel diminution of its rate of recurrence and supposed costs.

A wide range of proofs suggests that the ability to provide a bigger or a smaller reserve is simply a question of anatomy. That is, **people who display of a big “brain” are able to endure greater injury load without clinical signs** and, on the other hand, those who have a smaller brain demonstrate less degree of tolerance, which is translated into a major risk of clinical indications of the Alzheimer disease and other neurogenerative processes (see as a recent example; Mortimer JA et al 2008(2)). Many studies have supported this association between the size of the brain and the indication of neurogenerative diseases, in the sense of greater size-protection, less size-risk. The size of the brain is to a certain extent determined by genetics but social-environmental factors are also influential. These can be the quality of the food during the development and the history of the diseases that they have suffered (traumas, etc.), or behavioural or personal factors (f.ex. drug consumption, alcoholism etc.).

Another series of proofs show that in addition to this “Brain Reserve” based solely on anatomy, other vehicles exist that offer a more physiological reserve. In this case, function prevails over the structure and quality prevails over quantity. It is not a question of having a “bigger” brain, it is important that it works “better”. These types of vehicles are closely related to the cognitive capacity of each subject, and from there derives the name “Cognitive Reserve”. Furthermore, they encourage a greater degree of functional efficiency of the brain that helps to compensate the effects of brain injuries (skilfully developed by Stern Y 2006(3)). The cognitive capacity of every subject is also partly determined in genetic terms, which would be the inherent intelligence of each one.

Importantly, its development depends also to great extent on the environment and behaviour. The level of cognition that each person has, and therefore Cognitive Reserve, is directly related to the level of education achieved and to the level of cognitive stimulation maintained during the lifetime. This applies whether this stimulation proceeds from labour activities, interests and activities related to hobbies, or the social relations that one has. Already, numerous essays argue that individuals who enjoy a greater level of education, develop work and interests with greater cognitive requirements or take pleasure in social relationships, are of less risk to be diagnosed with Alzheimer disease or other dementias than others who have less studies and a restricted social network, or their work and interests show less cognitive demands (a systematic and meta-analytic revision can be found in Valenzuela M and Sachdev P 2006(4)). This is the reason for explaining illiteracy and loneliness as two important risk factors that can provoke this type of processes.

Individuals whose brain is of great size are able to endure a greater load injury without a clinical indication.

Brain and cognitive reserves are neither static elements nor are they mutually exclusive. They are interrelated. In fact, it is known that greater brain size usually is associated to better cognitive skills. On the other hand, animal models with enriched environment, an experimental model of cognitive stimulation, show that this stimulation is not only followed by a greater cognitive efficiency but also, by an increase in the number and size of neurons. That is, of a greater brain. These experimental models have made it possible to confirm that when the environment is enriched and applied to transgenic mice with diverse neurogenerative diseases, it produces a delay of the initiation of the disease and a less degree of pathological damages (in Berardi N et al 2007(5) the effects on the transgenic Alzheimer disease model are demonstrated).

Brain and cognition reserves are built up as defensive mechanisms against indications of neurogenerative processes, which are manipulative and consequently subject to be reinforced. The important point is, and the one of relevance, many of the measurements able to increase these reservations, as for example improvements on the socioeconomic level or the population's education, continuous learning, lengthening the time on the labour market, post-retirement education, and encouraging an active aging, go beyond the level of the individual and the framework of pure health-care. They also involve other sectors of the community (economy, education, etc.) and even political decisions.

Welcome to the battlefield and sleeves up!

Recommended reading:

- (1). Bennett DA, Schneider JA, Arvanitakis Z, et al. Neuropathology of older persons without cognitive impairment from two community-based studies. *Neurology* 2006; 66: 1837-1844.
- (2). Mortimer JA, Snowdon DA, Markesbery WR. Small head circumference is associated with less education in persons at risk for Alzheimer disease in later life. *Alzheimer Dis. Assoc Disord* 2008; 22: 249-254.

(3). Stern Y. Cognitive reserve and Alzheimer disease. *Alzheimer Disease & Associated Disorders* 2006; 20: 112-117.

(4). Valenzuela MJ, Sachdev P. Brain reserve and dementia: a systematic review. *Psychol Med* 2006; 36: 441-454.

(5). Berardi N, Braschi C, Capsoni S, Cattaneo A, Maffei L. Environmental enrichment delays the onset of memory deficits and reduces neuropathological hallmarks in a Mouse model of Alzheimer-like neurodegeneration. *J Alzheimers Dis* 2007; 11: 359-370

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