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REVIEW ARTICLE

Brain disease, connectivity, plasticity and cognitive therapy: A neurological view of mental disorders☆

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Abstract
Introduction: Our conception of the mind-brain relationship has evolved from the traditional idea of dualism to current evidence that mental functions result from brain activity. This paradigm shift, combined with recent advances in neuroimaging, has led to a novel definition of brain functioning in terms of structural and functional connectivity. The purpose of this literature review is to describe the relationship between connectivity, brain lesions, cerebral plasticity, and functional recovery.
Development: Assuming that brain function results from the organisation of the entire brain in networks, brain dysfunction would be a consequence of altered brain network connectivity. According to this approach, cognitive and behavioural impairment following brain damage result from disrupted functional organisation of brain networks. However, the dynamic and versatile nature of these circuits makes recovering brain function possible. Cerebral plasticity allows for functional reorganisation leading to recovery, whether spontaneous or resulting from cognitive therapy, after brain disease.
Conclusions: Current knowledge of brain connectivity and cerebral plasticity provides new insights into normal brain functioning, the mechanisms of brain damage, and functional recovery, which in turn serve as the foundations of cognitive therapy.

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PALABRAS CLAVE
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Enfermedad cerebral, conectividad, plasticidad y terapia cognitiva. Una visión neurológica del trastorno mental

Resumen
Introducción: La relación entre mente y cerebro ha evolucionado desde el clásico dualismo hasta los conocimientos actuales que ponen de manifiesto que las funciones mentales son el resultado de la actividad cerebral. Este cambio de paradigma, junto con los recientes avances en diferentes técnicas de neuroimagen, ha dado lugar a una novedosa concepción del funcionamiento cerebral en términos de conectividad estructural y funcional. El objetivo del presente trabajo es describir la relación entre conectividad, lesión cerebral, plasticidad cerebral y recuperación funcional.
Desarrollo: Si la función cerebral surge de la organización en red del cerebro como un todo, la disfunción cerebral se puede producir por una alteración en la conexión de estas redes. Así, a partir del modelo conectivista, los trastornos cognitivos y del comportamiento que aparecen tras una afección cerebral se describen como consecuencia de una alteración en la organización funcional de las redes cerebrales. Sin embargo, la pérdida de funciones puede ser recuperada gracias a la capacidad de los circuitos de ser dinámicos y versátiles. La plasticidad cerebral permite una reorganización funcional que llevará a una recuperación, espontánea o potenciada con terapia cognitiva, después de algún tipo de enfermedad cerebral.
Conclusiones: El conocimiento de la conectividad y la plasticidad cerebrales proporciona una nueva perspectiva desde la que entender el funcionamiento cerebral en condiciones normales, los mecanismos del daño cerebral y los de la recuperación funcional, constituyendo las bases para el desarrollo de la terapia cognitiva.

Introduction

For many years, mind and brain were regarded as distinct entities. This dualism, most famously defended by René Descartes in the 17th century, has long been a cornerstone of Western culture. Technology and the development of neuroscience as a discipline have since led to the emergence of a new conception of mind as the result of processes occurring in the brain. This new premise requires us to discover how the brain must work to produce such a complex system as the ''mind'': as has previously been stated, ''there can be brain without mind, but there can be no mind without brain'' (E. Díez-Tejedor). Localisationist theories argued that each part of the brain is responsible for a specific function; according to this view, a localised brain lesion would selectively damage certain cognitive processes. However, these brain maps exclude many functions that have classically been attributed to the concept of mind: behaviour, personality, mood, and affect, among others. Although evidence already existed that specific brain injuries could cause behavioural alterations, it was the famous case of Phineas Gage in the mid-19th century that led to investigation into the biological basis of such mental processes as emotion management or decision-making.[1] Moving beyond the localisationist approach, the brain was understood to function by means of complex, interconnected circuits involving both the cerebral cortex and the white matter.

However, it has long been known that the brain is able to modify itself in response to certain stimuli. Ramón y Cajal's assertion that ''any man could, if he were so inclined, be the sculptor of his own brain'' was without doubt a reference to brain plasticity. Nonetheless, several decades passed before the discovery would be made that the brain not only has this capability, but is also able to form new nerve cells; Cajal doubted this in his day.

This article reviews several aspects of brain disease and how it is related with connectivity and plasticity, as well as the fundamental aspects of cognitive therapy techniques based on these functions.

Connectivity and brain disease

The human brain is a complex network of structurally and functionally interconnected regions; brain function arises from the networked organisation of the organ as a whole. Brain lesions can therefore cause functional deficits by means of 2 basic mechanisms: local cortical dysfunction in the affected region, and spatially separate dysfunction caused by interruption of the connection between 2 areas.

Research into the circuits and networks constituting the highly complex organisation of the brain allows us greater insight into the structuring of the higher cognitive functions and their involvement in various neurological diseases. Indeed, we now know that the deficits associated with such disorders as Alzheimer disease, multiple sclerosis, traumatic brain injury (TBI), schizophrenia, depression, autism, etc., are accompanied by brain connectivity alterations.