EDITORIAL

Domain general neurocognitive networks

A new player in poststroke recovery from aphasia?

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The clinical neurology of speech production has long been mounted on the assumption of functional localization to the Broca area. Since its inception, however, this notion has proved controversial.[1] The Wernicke-Lichtheim tradition, which continues, in its more recent incarnations, to underpin worldwide neurologic practice, postulated a strictly localized center for speech production. A second line of thought, represented by neurologists such as Hughlings Jackson, Sigmund Freud, and Alexander Luria, conceived of language production as hierarchical gradients organized around, but extending beyond, motor mechanisms of speech production. Arguably, the strictly regional model has exerted a greater influence on neurologic practice, giving weight to the notion that residual poststroke production of meaningful language relies primarily, if not entirely, on the extent of regional destruction.

The advent of functional neuroimaging has gradually displaced a narrowly regional neuroanatomy of complex language production, in favor of a more distributed view,[2] and the idea that complex language and other cognitive functions depend on functional coherence[3] between distributed networks is a hallmark of modern functional neuroanatomy. In an expansion of this idea, a dynamic anticorrelated mode of network coherence or synchrony is likely an intrinsic feature of brain organization during the performance of resource-intensive cognitive tasks.[3] More specifically, the performance of complex tasks is accompanied by increased activity in networks that are routinely recruited by specific functions (such as speech production) and decreased activity in functionally nonspecific networks. In this issue of *Neurology*®, Geranmayeh et al.[4] studied the role of multiple distributed brain networks associated with residual speech production after left hemispheric aphasiogenic stroke. In the normal brain, networks specific to speech production were activated, while networks that subserve general background cognitive functions, such as the distribution of attention, were deactivated. In the poststroke group, this inverse pattern of connectivity was altered. The best predictor of speech production is the relationship between networks specifically involved in the task, and networks that play a modulating role in all complex cognitive functions. By contrast, clinically intuitive markers such as activity in individual networks or lesion volume predicted speech outcome poorly.

Functional recovery after aphasiogenic infarction has been attributed to contralateral transfer to homologous language regions, or to ipsilateral reorganization in preserved perilesional tissue.[5] In a paradigm-shifting exploration, however, Geranmayeh et al.[4] found that language recovery is more likely to be conditional on the restoration of dynamic anticorrelated connectivity between left hemisphere task-specific and domain-general networks than on high levels of speech-activated recruitment in the right hemispheric homologue of the speech-specific network. To put some structural substance on this highly neurofunctional idea, the speech-task-specific network underlying production of meaningful language occupies a left fronto-temporo-parietal distribution (LFTP), and the infarctions studied were variously located over this broad region. The domain-general, or default mode network, is medially and ventrally distributed, and remote from infarcted tissue. The LFTP appears to connect with the default mode network through the posterior cingulate cortex.

From a practical neurologic standpoint, the findings of Geranmayeh et al. do not diminish the well-founded principle that strokes in eloquent cortex cause disturbances in the production of meaningful language.[6] They do, however, underscore the existence of a more widely distributed speech-specific cortex than envisaged by classical models of language representation in the brain. They might also serve to diminish the clinician's confidence in the value of lesion size as a predictor of language recovery, as well as the optimism with which anterior right hemispheric recruitment on poststroke language fMRI is sometimes greeted. In showing that poststroke speech outcome is dependent on coherent fluctuations between networks that are specific to speech production and those that are not, their article unfolds a future prospect of the rational use of neurostimulation to optimize poststroke recovery.

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