Relating cytoarchitectonic differentiation and interareal distance to corticocortical connection patterns in the cat brain

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Information processing in the brain is constrained by structural connectivity on multiple scales. However, the principles governing the organization of corticocortical connectivity, particularly the existence, density and laminar origin and termination patterns of projections, remain elusive. Here, we tested three models of relationships between the organization of cortical structure and features of connections linking 48 areas in the cat cerebral cortex. Factors taken into account were the relative cytoarchitectonic differentiation (structural model), relative spatial position (distance model), and relative hierarchical position (hierarchical model) of cortical areas.

Structural differentiation as well as distance (which were themselves uncorrelated) correlated strongly with the existence or absence of interareal connections, whereas no correlation was found with relative hierarchical position. Moreover, a strong correlation was observed between the laminar projection patterns and structural differentiation. Additionally, architectonic differentiation correlated with the absolute number of corticocortical connections formed by an area, and varied characteristically between different cortical subnetworks, including a module of hub areas.

Thus, structural connectivity in cat cerebral cortex can, to a large part, be explained by the two independent factors of relative structural differentiation and distance of brain regions. Hierarchical area rankings, by contrast, did not add explanatory value. As both the structural and the distance model were originally formulated in the macaque monkey, their applicability in another mammalian species suggests a general principle of cortical organization.