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EDITORIAL

Brain Connectivity: A New Journal Emerges

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We are excited about the launch of this new journal ***Brain Connectivity***, which focuses on a field that has been rapidly evolving over the last several years. This journal will bring together all aspects of the functional and structural connections of the human and animal brain regardless of experimental technique. Improvements to existing neuroimaging modalities have provided unprecedented spatial and temporal resolution, and new computational and neurophysiological models are further propelling connectivity research forward. Additionally, there has been a recent trend toward the use of multimodal experiments to obtain complementary information about neural connectivity and to promote a better understanding of the underlying neurophysiological mechanisms of the phenomenon. We believe this unprecedented level of growth in a focused area of neuroscience presents a unique opportunity to begin this endeavor and to shape the future of brain connectivity research.

The history of brain connectivity research starts with the founder of modern neuroscience, Santiago Ramón y Cajal. His detailed illustrations of cellular connections in the brain and staunch defense of neuron doctrine form the basis of the field. Work by his contemporary, Korbinian Brodmann, and others segmented the brain into distinct cytoarchitectonic regions, many of which were further defined functionally by Wilder Penfield, using electrophysiological mapping. However, the study of connectivity is distinct from static brain mapping. Connectivity research is concerned with anatomical pathways, interactions, and communication between distinct units of the central nervous system. These units can be categorized into levels of micro- (individual neurons), meso- (columns), or macro- (regions) scales. At this point in history, we are constrained by the limits of temporal and spatial resolution in modern *in vivo* imaging techniques (magnetic resonance imaging [MRI], electroencephalography [EEG], positron emission tomography [PET], etc.) to study the brain. Consequently, the main focus of this journal will be at the network or systems level of connections. However, we intend to bring together researchers working at all scales.

Beyond scale, connectivity can also be broken into structural and functional domains, with each subdivided further into static and dynamic components. Static components are defined by the regions and wiring in which communication and processing occurs. Dynamic components can be described by the functional relationship between static components. For example, functional connectivity, described as temporal coherence between physically distant activity, and effective connectivity, described as networks of directional influences of one neural element over another. Static connectivity can be measured by anatomical properties using a number of imaging methods, including high-resolution magnetic resonance (MR; cortical thickness), diffusion tensor imaging (DTI; white matter tractography), and histology (myelination). Dynamic connectivity can be measured by a wide variety of techniques, including methods with a fast timescale capable of measuring causality, such as EEG, or methods that can provide information about the spatial distribution and strength of dynamic connections, such as resting-state functional connectivity MRI (rs-fcMRI). The evolution and refinement of imaging modalities will drive brain connectivity research forward. Although we are both trained MR biophysicists, we are committed to keeping this journal independent of a specific technique.

In the past few years, there has been an almost exponential increase in the number of publications in neuroimaging and, in particular, on topics related to brain connectivity (see Fig. 1; data from PubMed, search term: *brain connectivity*). Figure 1 shows the number of publications indexed by PubMed since 1969 when the first article using the term *brain connectivity* appeared. The bar chart shows the number of publications for each 5-year period. The last bar in the graph is obtained from only 2 years. The exponential trend seen in

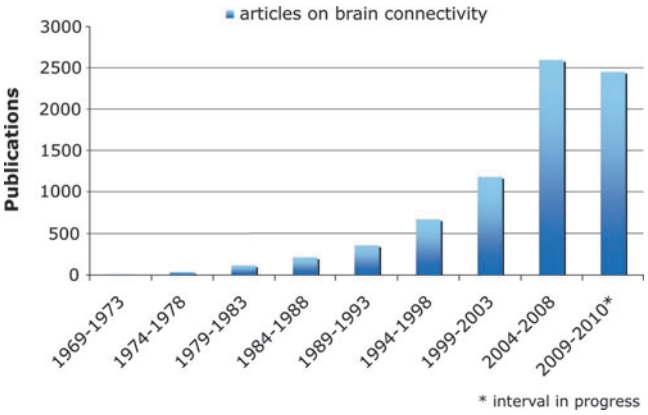

FIG. 1. Number of publications in the PubMed database using the search term *brain connectivity* vs. time in 5-year increments.

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the graph shows a clear need for focus and expertise in a single venue. While initial papers focused primarily on the development and refinement of brain connectivity methodologies using, for example, single cell recordings, an increasing number of recent papers has expanded brain connectivity approaches to cognitive neuroscience and clinical questions. Critically, these methods have fostered an appreciation for the utility of brain connectivity to better understand brain structure, brain function, and the important interaction and relationship between the two.

Brain Connectivity will be the first journal devoted exclusively to structural and functional associations in the human and animal brain. There are many other neuroimaging journals available. Some focus on specific brain regions while others cover technological developments and applications. Still other journals focus exclusively on specific diseases and conditions. We believe that a single journal that is dedicated exclusively to brain connectivity and that serves as a single resource to cover all aspects of the phenomenon would increase the efficiency and the spread of ideas. The Journal will be broad in terms of the number of technologies and modalities covered, but will be narrowly focused on a specific subfield of neuroscience. Our goal is to steer the discipline, ensuring the field grows properly and consistently, making certain there is a common direction and purpose, in addition to developing a common language among researchers.

We envision that the field of connectivity research will continue to expand and that it will not only address major questions about how the brain functions and develops, but also help make available new methods to diagnose and treat injury and disease. Many researchers foresee the fusion of genomics and connectomics, with connectivity methodology providing phenotype information about a particular unity of heredity. We hope our journal will follow such trends but also help with such mundane, but important, problems such as how to analyze, visualize, and organize connectivity imaging data.

The Journal will include sections for comments and controversies, expert review articles, rapid communications, and reports of original research. It will be interdisciplinary in nature, including articles from diverse fields covering all aspects of theoretical and experimental neuroscience. Every effort will be made to provide a fair, expert, and timely review of the articles submitted to the journal. Our goal is to set our first-decision deadline to 21 days. Once accepted, manuscripts will be made available online in their original, raw form within 72 hours.

The first issue sets an example of how we envision the Journal moving forward. The initial articles cover a wide range of connectivity topics and methodologies. We are quite honored to have two excellent review articles by two of the most important pioneers in brain imaging research. Dr. Marcus Raichle provides an excellent review of resting-state brain connectivity, provocatively entitled "The Restless Brain," and Dr. Karl Friston expertly discusses the various aspects and current trends of functional and effective brain connectivity.

Six original and diverse manuscripts complete the issue, each describing new research using a variety of modalities, including diffusion tensor imaging (DTI), magnetoencephalography (MEG), rs-fcMRI, real-time fMRI, and computational modeling. In the first article, Dr. Kenichi Oishi and colleagues perform DTI of the macaque brain for comparison to the human brain. They describe species-conserved, U-fiber white-matter tracts, which may provide new opportunities to further understand brain anatomy and function. In the second paper, Dr. Dante Mantini and colleagues present a detailed and comprehensive pipeline for resting-state MEG data analysis in brain connectivity. In the third article, Dr. Kathryn Cullen and colleagues combine fMRI and behavioral results to compare young women with bipolar disorder with their healthy counterparts. They demonstrate connectivity differences involving the amygdala during both neutral and overt fear experiments that correlate to clinical measures. In the fourth paper, Dr. Young-Ah Rho and colleagues demonstrate that transient neural synchronization between two sites may lead to the emergence of ultra-slow frequency fluctuations in the blood oxygen level dependent (BOLD) signal at another (third) site, with critical implications for neuroelectric synchronization patterns at the network level. In the fifth article, Dr. Andrzej Jesmanowicz and colleagues develop a method to accelerate MR scan acquisition using gradient-recalled (GR) echo-planar imaging and radio frequency (RF) slice phase tagging, demonstrating a twofold slice acceleration using an eight-channel RF receiver coil in rs-fcMRI applications. Lastly, Dr. Michelle Hampson and colleagues describe a biofeedback and real-time MR experiment using both fMRI and connectivity analysis, with the suggestion that this may allow subjects (particularly in cases of Tourette's syndrome) to develop greater conscious control over activity in their supplementary motor area by reducing the influence of cortico-striato-thalamocortical loops in the region.

Brain Connectivity has a strong editorial board consisting of many experts representing a variety of disciplines. These individuals are founders in the field. We have already benefited from their significant contributions and leadership.

The editors would also like to thank the Publisher, Mary Ann Liebert, and her gracious staff including Vicki Cohn (managing editor). We are greatly indebted to the Publisher's tremendous support and foresight in helping to found this journal. If the last 10 years of literature serves as a guide, we are looking forward to many exciting and high-quality manuscript submissions that promote new ideas and methods and drive our field forward. We eagerly anticipate the next 10 years (and beyond) of invention and discovery.

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