A detailed characterization of the human brain, its structural and functional underpinnings, remains on the frontier of modern science. Neurological research is important not only for its intrinsic interest, but for the purpose of better understanding (diagnosing and treating) neurological disorder as well. Happily, along with many other fields, neuroscience is entering an era of "Big Data" in which a new approach is possible: allow the data to suggest a theory, which may then be validated against independent data. In this poster we summarize ongoing work applying this approach to the analysis of functional Magnetic Resonance Imaging (fMRI) data from a 243-subject study of the adolescent, resting-state brain. Computational techniques inspired by biological evolution are employed to discover and mathematically characterize interactions among regions of interest (ROI), *without* making linear or univariate assumptions. Statistics of the resulting interaction relationships comport with recent independent work, constituting a preliminary validation. Moreover, new nonlinear interactions are suggested that are not discoverable by current methods of analysis. Upon further successful testing, the methodology will be employed to enhance the theoretical framework within which we understand and model the human brain.