# Simplistic Theories for Complex Phenomena

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Society charges scientists with finding theoretical order in apparent chaos. Newtonian physics can replace wandering planets with the orderly Copernican solar system. Biologists aspire to such satisfaction, but we have a problem – biological systems evolve. Primitive organisms “invented” sliding filaments, servocontrol and synaptic plasticity as the mechanisms for motility, sensorimotor control and adaptation but their descendants survived by adding countless refinements. We laud the discoveries of these primitive mechanisms but then we embarrass them by trying to make them account for the phenomena of the refinements.

More recently, computational technology has transformed statistical correlation into myths of causation.  It is comforting to see large bodies of experimental data reduced to population vectors, equilibrium points, synergies and optimizations. Some of these reflect actual features of the problems that they are supposed to solve, but these alleged theories have no physical existence in the nervous system. In their pure forms, each has been falsified by clever experiments, only to be resurrected with creaky refinements that would have caused the whole theory to be ignored in the first place.

We understand these pitfalls and yet we become ever more imprisoned by them. The recent explosion of experimental data and underlying mechanisms and their inter-relationships is overwhelming. In order to focus attention on one small subsystem of a complex system, we must pretend to understand it by simplifying and summarizing what is going on elsewhere. When we observe complexity in our own subsystem, we must reduce it to similar simplifications to support the pretensions of our colleagues. We find ourselves gainfully employed in the construction of “The Music of the Spheres,” that orderly but fictional alternative to the Copernican solar system.

Because we deal with biological complexity rather than physical principles, it is unlikely that our myth-building will come to as compelling a denouement as the solar system. Instead of hoping for one brilliant mind to distill truth from complexity, we must develop teams that embrace the complexity of the subsystems in order to find order in the relationships among them.  David Marr provided a framework for this process. A top level “theory of computation” is necessary to structure the requirements for each subsystem’s computational algorithm, followed by the neural implementation of that algorithm. We have a lot of observations on the neural implementations of biological subsystems but no theory of computation. Instead of trying to infer bottom-up from implementations to algorithms, we need to theorize top-down.  This is risky.  The “theories” mentioned above merely created algorithms to match available data, essentially a sure thing for a clever mathematician.  The theories we need are grand schemes that will (mostly) fail ignominiously (as did Marr’s for vision).