

Complex Dynamical Systems and Chinese Medicine

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We propose to contribute an article to Handbook of Philosophy of Science (Philosophy of Complexity, Chaos and Nonlinearity volume) focussing on fundamental philosophical issues raised through the application of complex dynamic systems theory to Chinese medicine.

The application of complex dynamic concepts to Chinese medicine raises fundamental issues in three areas of concern to philosophers: theory, practice and research methodology. We will here present a brief example to illustrate the type of developments that interest us: A fundamental concept in Chinese medical theory is the *Wu Xing*. Early commentators translated this term as ‘five elements’, drawing analogy with classic Greek cosmology. However, late in the Twentieth Century it was acknowledged that *wu xing* is a dynamic concept; thus the term ‘five phases’ became preferred. Here the word ‘phases’ refer to steps in a process, akin to the phases of the moon. This is closer in meaning to ‘*wu xing*’. However, by reading the classic texts through a dynamic systems interpretive framework we can see that the ‘*wu xing*’ refers to a set of five coupled oscillators. Thus adoption of a dynamics systems framework to articulate Chinese medicine not only yields linguistic clarity, but also allows us to explore with mathematical precision the implications of the traditional theory. Furthermore, such concepts as *wu xing* play a crucial role in contemporary Chinese medical practice: a complex systems approach can also yield a better way to understand this practice.

We will provide a review of the literature that applies complex dynamics to Chinese medicine (also making some reference to other Asian traditions, including e.g. Ayurvedic). This will in itself be a useful contribution, since most of this work is published outside orthodox philosophy of science periodicals; it will alert a wider audience to the existence of this work for the first time. We will include both Chinese and English-language sources in this review.

In addition to the literature review we will include an overview, drawn from our original work in the area. In addition to the discussion of articulating theory and practice of Chinese medicine alluded to earlier, we will focus on two other areas of philosophic concern: the concept of disease in Chinese medicine and research methodologies for Chinese medicine derived from complex dynamic approaches.

It is from the research literature on the biomedical approach to dynamic disease that we derive our inspiration for new research methodology for Chinese medicine. Leon Glass and Michael Mackey coined the term ‘dynamical disease’ to identify disease that occurs when natural rhythms of the body become abnormal. The outstanding example of such research has been done in the area of cardiology. One aim of such work is to detect subtle changes in ECG data by analysing the complexity of the signal (see <http://www.physionet.org/>). This will eventually lead to doctors having the ability to screen patients’ ECGs enabling them to detect cardiac arrhythmia by measuring the complexity of the data using nonlinear signal processing analysis. Knowledge of the presence of arrhythmia will allow doctors to predict when patients are in danger of heart failure. While The dynamical disease research program is most developed in the area of cardiology, there has been progress in many other areas including Parkinson’s disease and

circadian rhythms.

There has been some recent work on the concept of disease in the Western scientific tradition - most prominently in Paul Thagard's *How Scientists Explain Disease*. In this book Thagard provides a hierarchical model of disease explanations based on the classification of disease in terms of various categories and sub-categories. We believe his account to be quite accurate for the bulk of medical research, practice and theory, yet there is no neat way to fit dynamical disease into Thagard's account. On one hand it makes sense to say that every disease (in fact every instantiation of a disease) has its own dynamic. But on the other hand, the leading account of how scientists explain disease makes no mention of disease dynamics. This is particularly troubling from the perspective of Western biomedicine since dynamical disease is becoming an important research topic.

The lack of a mainstream medical appreciation of dynamical disease also explains why there is so much misunderstanding of Chinese medicine within biomedicine. From a Chinese medical perspective nearly all disease is dynamical disease. We will summarise our work on articulating the notion of dynamical disease extant in Chinese medicine, in which systems concepts and principles are central. We believe this is a crucial step in forming the foundations of a dialogue between Chinese medicine and biomedicine.

For decades now such researchers as Glass and Mackey, Goldberger, Garfinkel and Winfree amongst many others have applied the methods derived from nonlinear dynamics (including chaos theory and complex dynamic systems) to investigate biological rhythms. This is the research that has given rise to the concept of dynamic disease. So far, there have been only a few studies (including one by one of the authors of this proposal, D.R.) that apply these methods to complementary and alternative medicine. We will summarise our work developing such methodology for Chinese medicine including, most significantly for a philosophical audience, the theoretical commitments of Chinese medicine that form a rationale undergirding such an approach to research in that area.

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