

Original Research Article

Reflections on the Scientific Nature and Modernisation of Traditional Chinese Medicine from the Perspective of Systems Science

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Abstract

Due to differences in scientific and cultural backgrounds, the theoretical system of Traditional Chinese Medicine did not pass the test of the "principle of sensory priority" prevalent during the era of classical physics. Consequently, it was not organically integrated into the modern scientific system founded upon the basis of classical physics. For an extended period, its scientific validity has been widely questioned. However, modern scientific research has indeed abandoned the absolute status of this principle. An appropriate black-box nature is more aligned with the developmental direction of cutting-edge disciplines such as systems science. The commensurability between systems science and Traditional Chinese Medicine can provide robust support for the scientific validity of TCM theory and offer insights for its modernisation.

Keywords

Systems Science, Scientific Nature of Traditional Chinese Medicine, Modernisation of Traditional Chinese Medicine, Systems Traditional Chinese Medicine

1. Introduction

With the continuous development of scientific theories and the increasing demand for addressing complex issues, the limitations of traditional reductionism have become increasingly apparent, giving rise to systems science. The core systems concept shares a high degree of homogeneity with the holistic approach of traditional Chinese medicine (TCM), which is where TCM's scientific nature lies within this advanced methodology, compared to other natural science disciplines rooted in reductionism (Qian, 1998). Based on the commensurability between systems science and TCM, this paper reflects on the

scientific nature and modernization of TCM's theoretical framework.

2. The Scientific Nature of TCM Validated through Modern Scientific Research

Due to differences in scientific and cultural backgrounds, TCM theories did not pass the test of the "principle of sensory priority" during the era of classical physics and, as a result, were not organically integrated with the modern scientific system established on the foundations of classical physics. For a long time, its scientific nature has been widely questioned. However, if this principle were to be strictly adhered to, even cutting-edge disciplines such as systems science would not pass the test of scientific validity. Indeed, with the continuous development of scientific theories, particularly since the advent of relativity, modern scientific research has abandoned the absolute status of the "principle of sensory priority." That is to say, a theory does not necessarily need to collect experiences—such as vital energy (qi) and meridians, whose existence cannot be directly perceived—through sensory means, nor reduce them to identical data obtainable by machines and equipment for validation. Instead, it only needs to pass the "principle of empirical verification" (Zhang & Sun, 2022), validating the direct empirical basis of the theory or the empirical basis of its inferences. For example, self-organised criticality theory is validated only through experiments such as the sandpile experiment, which test its theoretical predictions, while the constancy of the speed of light is verified only through experiments such as the Michelson-Morley experiment, which test its implications.

The theoretical framework of traditional Chinese medicine has undergone thousands of years of rigorous clinical practice, testing, and refinement, possessing a profound foundation of empirical facts. The digitised empirical data derived from modern clinical practice guided by its theories—such as clinical observation data showing statistically significant results when doctors apply the "reinforcing earth to generate metal" method, based on the doctrine of visceral manifestations, to treat allergic conjunctivitis in children (Gui, Liu, & Chen, 2023), or when using the "dredging the Xuanfu and resolved toxin" method, based on the Xuanfu theory, to treat plaque psoriasis (Song, Wang, Yang, et al., 2013)—have been statistically validated. The clinical efficacy aligns with the theoretical expectations, thereby passing the "principle of empirical verification" as a test of the theory's scientific validity.

3. The High Homogeneity between TCM Holism and the Systems Concept as Collateral Evidence of Its Scientific Nature

As a leading-edge discipline, systems science plays a crucial role in the development of the natural sciences and has been decisive in the emergence and expansion of frontier fields such as systems ecology, systems biology, and systems medicine. The high homogeneity between TCM's holistic approach and the systems concept indicates that TCM theory shares commensurability with this advanced scientific framework. With qi monism at its core, TCM expands and deepens through the theories of yin-yang and the five phases, while the doctrines of visceral manifestation, meridians, and the Xuanfu represent their concrete application in human physiology and pathology. From the

perspective of systems science, the concept of qi serves as a medium that organically integrates these various doctrines, interlinking and interacting systems such as the zang-fu organs, meridians, and Xuanfu to collectively construct an open complex giant system of human physiology and pathology (Zhu, 2021; Qian, 2007).

Taking the Xuanfu system with its micro-level characteristics as an example, the Xuanfu serves as the pathways and portals for the ascent, descent, exit, and entry of qi. Its structure is refined and ubiquitous, meaning that qi acts as an intermediary, unifying the zang-fu organs, meridians, and Xuanfu into the structural foundation of the human body as an open complex giant system. Furthermore, as a lower-level system, the Xuanfu system interconnects higher-level systems such as the zang-fu organ systems and meridian systems.

In the practice of traditional Chinese medical treatment, applying methods to open the Xuanfu and regulate the movement of qi to adjust the Xuanfu system can unblock obstructed meridians, restore balance to dysfunctional zang-fu organs, and normalise the ascent, descent, exit, and entry of qi. This achieves therapeutic effects of mental clarity, smooth qi flow, and elimination of diseases. This is precisely based on the integrative and emergent properties of the human body as an open complex giant system. The various physiological and pathological systems of the human body are intrinsically interconnected. Therefore, in treatment, whether based on the Xuanfu, meridians, or visceral manifestation theories, it essentially involves the synergistic application of these theories. This approach not only utilises principles such as the generation and restriction of the five phases and meridian transmission to adjust higher-level systems like the zang-fu organs and meridians, exerting top-down causality to improve lower-level systems such as the Xuanfu, but also leverages the refined structure and unblocking function of the Xuanfu to regulate this lower-level system, exerting bottom-up causality to adjust higher-level systems like the zang-fu organs and meridians. This fully reflects the multi-level, multi-element, and multi-relational characteristics of systems theory.

The commensurability between Traditional Chinese Medicine and systems science renders it mutually reinforcing with cutting-edge systems medicine (Tsinghua University, 2017; Jin & Jin, 2019). In contrast, modern Western medicine, founded upon modern biological sciences such as anatomy, physiology, and pathology, prioritises the investigation of microscopic mechanisms. It exhibits a tendency to employ reductionist methodologies, simplifying complex diseases into localised problems, deconstructing the whole into constituent parts, and amplifying the influence of isolated factors. This approach lacks a profound appreciation for the integrative and emergent relationships inherent in systems. Owing to the absence of a highly self-consistent complex systems perspective (Zhu, 2021), the theoretical models of Western medicine often prove inadequate when addressing certain complex conditions, such as chronic diseases, multi-organ pathologies, and novel diseases or their new manifestations. Conversely, therapeutic interventions based on the theories of Traditional Chinese Medicine for such conditions can yield favourable treatment outcomes that elude explanation within the Western medical paradigm. This very capacity underscores the scientific validity of Chinese medicine.

4. Systems Traditional Chinese Medicine Research as a Viable Path towards Modernisation

To foster a broader understanding of TCM theory within modern scientific domains whilst preserving the core of its theory of holism, promoting research in Systems Traditional Chinese Medicine presents a feasible and promising path. It remains crucial, however, to carefully consider the degree of compatibility between systems science and the theoretical framework of TCM, avoiding forced or mechanistic correlations. The central tenet must be to maintain TCM theory as the principal foundation, utilising the methodologies of systems science and incorporating diverse empirical research approaches. The objective is to utilise TCM theory to integrate modern scientific research findings and their clinical applications (Qian, 1998).

4.1 Advantages of Systems Traditional Chinese Medicine in Empirical Research

Although modern empirical research in Traditional Chinese Medicine has yielded certain achievements, it generally remains insufficient in integrating the microscopic and macroscopic perspectives. This is concretely manifested in an overemphasis on the microscopic behaviour of individual particles and a lack of in-depth connection to the macroscopic phenomena of holistic substances within a complex systems view. Within the framework of modern scientific theory, the process of understanding natural truth is infinite, requiring continuous expansion and enrichment to adapt to an ever-changing objective world and ever-improving cognitive capabilities. Therefore, the mechanistic understanding of experimental data characteristic of Western medicine must not be rigidly applied to the theoretical system of TCM. As mentioned previously, provided a theory can predict experimental and observational outcomes, an appropriate black-box nature is more aligned with the direction of cutting-edge modern science. The empirical research direction within Systems Traditional Chinese Medicine conforms to this very characteristic (Zhu, 1989). To tangibly enhance the reproducibility of TCM theory, it is advisable not to over-scrutinise the intuitive internal workings corresponding to individual data points. Instead, this should be superseded by informatised empirical research methods. For instance, by utilising pathway-specific datasets corresponding to meridian structures, one can mine for quantifiable indicators of various physiological and pathological concepts, as well as medicinal property concepts, within the meridian system. This approach aims to enable more precise application of TCM theory in guiding practice and enhance its universal applicability.

4.2 The Advantage of Systems Traditional Chinese Medicine in Advancing Diagnostic Standardisation

Promoting the standardisation of TCM diagnosis can enhance the applied value and dissemination of TCM theory, representing an essential path towards its modernisation. Presently, various scholars are researching the application of modern scientific methods—such as AI (Zhao, Guo, Pang, et al., 2022), three-dimensional laser scanning (Qin, 2023-05-30), photoacoustic imaging (Qin, 2023-04-25), pressure sensing (Wang, 2019), and image recognition (Zhang, Shi, & Zhang, 2007)—to TCM diagnosis. These efforts aim to establish standardised measurement and evaluation criteria for TCM diagnosis. However, due to factors like data collection methods, individual differences, and subjectivity, a universally recognised diagnostic standard is still lacking.

To advance the standardisation of TCM diagnosis, systems science methods can be incorporated into data collection and analysis to minimise discrepancies arising from practitioners' experience and to account for influencing factors such as temporal/spatial variations and constitution. The former can be addressed by, for instance, collecting extensive diagnostic data from numerous case studies of different practitioners and employing systems relationship modelling for analysis using the qualitative-to-quantitative meta-synthesis method (Qian, 1998), thereby reducing the interference of experiential variance. The latter requires emphasising the connotation differences of identical vital signs under the influence of factors like time, space, and constitution. Through systems analysis, refining rigid, uniform standards into differentiated criteria for various constitution types, geographical regions, and climatic conditions may represent a more suitable research direction.

4.3 The Advantage of Systems Traditional Chinese Medicine in Incorporating Theories from Frontier Disciplines

Frontier disciplines represent the most advanced level of current scientific knowledge and technological development, signalling future directions for various fields, and their theories should be continuously explored and assimilated. Due to the increasing demand within these disciplines for addressing complex problems, the systems science methodology is occupying an increasingly pivotal role in their research. Given the high homogeneity between the systems concept and TCM's holistic theory, the systems science approach can serve as a bridge connecting TCM with various frontier disciplines (Ma, 2019). This is conducive to absorbing the complex theoretical achievements of these disciplines while preserving the essence of TCM's holism theory. Taking quantum mechanics as an example, potential points of interaction with TCM include parallels between the "measurement collapse effect" and "the spirit governing qi," or between "quantum entanglement" and "like qi seeks mutual resonance." All these explorations necessitate a focus on the relational and dynamic nature of complex systems. While some progress has already been made in interdisciplinary research between quantum mechanics and TCM—for instance, some scholars have conducted comparative analyses of quantum field theory and qi monism (Ma & Shi, 2019), whilst others have utilised terahertz wave detection technology from a microphysics perspective to analyse the terahertz band characteristics of qi (Ren, Zhang, Fei, et al., 2017)—current research often focuses narrowly on certain physical attributes of qi. It generally lacks in-depth investigation into the integrated and mutually transformative nature of essence, qi, and spirit (jing-qi-shen). Furthermore, the breadth and depth of theoretical integration, the methodologies for applying scientific technologies, and the organic synthesis between the two require continuous expansion and deepening. By applying systems science methods and conducting complex system analysis based on nonlinear iterative equations of fractals and chaos, it is conducive to solving the above problems.

5. Conclusion

The theoretical system of Traditional Chinese Medicine has been validated through the principle of empirical verification and is supported by collateral evidence from systems science. Although it currently lacks extensive interaction with many disciplines in the modern scientific domain, this cannot negate its scientific nature. In the future, by utilising the methodology of systems science, the organic integration of TCM theory with modern science should be continuously strengthened. This will further enrich its theoretical framework and enhance its universal applicability, so that it is no longer confined to communication and dissemination within the traditional Chinese medicine industry, but can communicate and exchange without obstacles in the field of modern natural science, should be the promising path for its modernization.

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