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Perspective

The value connotations and generative logic of Gu Fangzhou's scientist spirit ☆

Xing-Yu Liu [a], Jing Liu [b], Xin-Qing Zhang [c,*]

[a] School of Health Humanities, Peking University, Beijing, 100191, China
[b] Administrative Office, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, 100730, China
[c] School of Humanities and Social Sciences, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, 100730, China

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ABSTRACT

The scientist spirit of Gu Fangzhou can be understood through six dimensions: patriotism, innovation, truth-seeking, dedication, collaboration, and education. Together, they define what made Gu Fangzhou a "People's Scientist" in the truest sense. Drawing on this framework, the article traces how these qualities took shape under specific historical, theoretical, and cultural conditions. In doing so, it proposes an analytical pathway that may serve as a reference for case studies of scientist spirit.

1. Introduction

2026 marks the centenary of the birth of Gu Fangzhou, widely recognized as a "People's Scientist" in China. The "scientist spirit," centered on patriotism, innovation, truth-seeking, dedication, collaboration, and education, provides a basic analytical framework for understanding Chinese scientists.[1,2] To examine Gu's scientist spirit, it is necessary not only to explain what it consists of, but also to ask how it was formed—under what historical conditions, cultural traditions, practical challenges, and personal life experiences did these qualities emerge and take shape? This article approaches the subject through these two dimensions, deepening our understanding of Gu's scientist spirit while also prompting reflection on contemporary global polio control and the building of a global community of health for all.

2. The value connotations of Gu's scientist spirit

The scientist spirit is a valuable spiritual resource developed by scientific and technological workers through sustained scientific practice, an important component of the spiritual lineage of the Communist Party of China, and a vital source of spiritual motivation for building China into a leading country in science and technology. It is also a distinctive "cultural gene" capable of guiding the healthy development of science within particular historical, regional, and cultural contexts.[3]

2.1. Patriotism: commitment to the nation and service to the people

Gu spent his entire life honoring a single promise. In 1961, he vowed to Premier Zhou Enlai that "once our vaccine is produced, as long as all children under the age of seven across the country receive it, poliomyelitis will certainly be eliminated".[4] In 2000, he signed the *Report on the Certification of the Eradication of Poliomyelitis in the People's Republic of China*. Keeping a single promise for four decades was perhaps the most unadorned expression of patriotism.

The starting point of this commitment was his life-changing decision to move from clinical medicine into public health. As he put it, "Being a doctor can certainly save many people, but disease prevention can benefit millions, even hundreds of millions."[5] Moving from treating "one person" to protecting "a generation", he recognized clearly that individual medical expertise has limits, whereas public health can build a protective wall spanning an entire era.

Poliomyelitis, or polio, was once among the most serious acute infectious diseases threatening children's health worldwide. During the major outbreak in Nantong in the 1950s, 1,680 patients developed paralytic disease, with a case-fatality rate as high as 27.5%.[6] By the early 1960s, the disease had spread to most provinces of China. Gu personally traveled to epidemic-stricken areas and witnessed parents carrying paralyzed children from place to place seeking treatment. This helplessness drove him to conquer polio, and it became the clearest expression of the ideal of "commitment to the nation and service to the people".[7]

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* Corresponding author.
E-mail: xqzhang@pumc.edu.cn (X.-Q. Zhang).

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2.2. Innovation: scaling new heights and pioneering new paths

Gu challenged conventional ways of thinking and actively opened up new areas of research. He conducted systematic innovation, taking application as the driver, national conditions as the constraint, and disease elimination as the goal, exploring new approaches at three levels: technical strategy, product formulation, and surveillance tools.

The first was strategic technological innovation. In 1959, most researchers abroad favored inactivated vaccines, yet Gu firmly chose the live attenuated vaccine. Repeated passage weakened the virus while preserving its ability to trigger immunity. After a single dose, the vaccine virus could replicate in the body and provide lasting protection. The production process was relatively simple and inexpensive, and the vaccine could induce intestinal mucosal immunity and interrupt person-to-person transmission of wild poliovirus. This approach suited China's large population and limited economic resources, demonstrating that sound scientific decision-making must be grounded in reality.

The second was innovation in dosage form at the product level. In 1962, working with Shanghai Sine Pharmaceutical Factory, Gu and his colleagues developed a sugar-coated pill that met several needs: it kept the vaccine active, could be stored and transported at room temperature, was easy for children to take, and could be produced at a manageable cost. It solved the practical problem that liquid live vaccines required low-temperature storage while cold-chain transportation was difficult to implement at the grassroots level.

The third was innovation in surveillance tools. From the mid-1980s to the early 1990s, Gu's team established China's first hybridoma cell line secreting monoclonal antibodies against poliovirus type II and developed diagnostic kits.[4] More than three decades of innovation demonstrated that the solution to eradicating the virus lies not in theoretical speculation but in practice. For instance, Arshad Quddus, the Acting Director of the World Health Organization's Polio Eradication Department, praised Gu for "demonstrating through action that science can safeguard the equity of life."

2.3. Truth-seeking: pursuing truth and maintaining scientific rigor

Gu's truth-seeking extended beyond the pursuit of "scientific truth" to attention to the realities of everyday life. In 1958, he was among the first in China to isolate poliovirus using monkey-kidney monolayer cell culture, identify the circulating viral types, and establish laboratory diagnostic standards. In 1964, he led the formulation of the *Regulations for the Manufacture and Control of Live Poliovirus Vaccine*, establishing a complete quality-control process covering seed-virus management, cell preparation, virus harvesting, and final-product testing, thereby filling a major gap in China's standardization system for biological products at the time.

His truth-seeking was never confined to the laboratory. He consistently asked whether children would be willing to take the vaccine and whether it could reach remote areas. This practical disposition of "bending down toward the ground" enabled technological inventions to genuinely improve the health and daily lives of ordinary people. From virus isolation and the formulation of regulations to refinement of the sugar pill, truth-seeking ran through his work, ensuring that innovation did not become cleverness for its own sake and that dedication did not degenerate into blind sacrifice.

2.4. Dedication: indifference to fame and fortune and devotion to research

Dedication is perhaps the most powerful dimension of Gu's scientist spirit. It was not a pose of self-sacrifice, but a commitment to placing the lives of others first.

In 1960, after animal trials of the live polio vaccine had been completed, safety testing in children became an urgent priority. Without telling his wife, Gu gave the first vaccine dose to his one-month-old son: "If my own child does not take it, how can I ask someone else's child to take it?".[4] Yet he never mentioned this episode in his writings. Instead, he would say that scientists such as Qian Xuesen and Qian Sanqiang had endured far greater hardships and that "what I have given up is nothing." He always measured himself against those who had suffered more, and so he rarely thought his own sacrifices worth mentioning. Academician Ji Xunming, current president of Chinese Academy of Medical Sciences & Peking Union Medical College, praised him for testing the vaccine on himself and even on his own child with great courage, sacrificing himself for the public good.

After the vaccine was successfully developed, he moved his entire family to Kunming and established the Institute of Medical Biology under extreme conditions, with no water, no electricity, and no housing. Over the following four decades, the institute produced 4 billion doses of live vaccine.[8] Yet in his later years he said, "I only did one thing in my life: a small sugar pill."[9] Through a lifetime of action, Gu demonstrated that "dedication is a conviction," offering the most vivid interpretation of the word "dedication" in the motto of Peking Union Medical College.

2.5. Collaboration: collective problem-solving and teamwork

The journey from developing a polio vaccine to eliminating the disease involved dozens of interconnected stages, including research and development, manufacturing, cold-chain logistics, vaccination, and surveillance. Failure at any one point could undo all previous efforts. This complexity made collaboration essential.

Gu's collaborative practice began with the formation of research teams. In 1959, the Ministry of Health established a collaborative research group for the live polio vaccine and appointed him its leader. By bringing together multiple institutions, he created a nationwide research and development network and built China's own vaccine-production base from the ground up under extremely difficult conditions. He subsequently promoted cooperation between the Kunming Institute and Shanghai Sine Pharmaceutical Factory to develop the sugar-pill formulation,[4] while coordinating with institutes in Chengdu, Beijing, and elsewhere to share responsibility for national vaccine production,[5] thereby creating a collaborative network spanning the entire chain.

At a higher level, collaboration was reflected in his institutional efforts to advance the discipline itself. In 1984, he represented China at the 22nd Council of the International Union of Immunological Societies, opening a new chapter in China's international dialogue in immunology. Beginning in 1985, he served as president and later honorary president of the Chinese Society for Immunology, continuing to promote international exchange. In 1990, he participated in a symposium in Taiwan province, contributing to cross-Strait medical exchanges. From research teams to a national production network and then to disciplinary platforms, Gu consistently put the mission first, bringing together diverse strengths and turning them into a collective force.

2.6. Education: supporting the next generation and advancing junior scholars

Scientists are not only pioneers of their fields but also guides who support the development of those who come after them. Eradicating polio was a project that would take beyond one lifetime and therefore depended on the growth of future generations.

After returning to Beijing in 1978, Gu continued working in a laboratory of the Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences, despite holding multiple positions. He quickly recognized the crucial value of emerging biotechnology for analyzing poliovirus antigens and making precise determinations of epidemic conditions, and he led a young research team in tackling these problems. From establishing hybridoma cell lines to refining enzyme-linked immunosorbent assays, he taught students not only techniques, but also how to judge

promising research directions and spot advances at the frontier. Collaboration brought together the strength of his contemporaries, while education nurtured younger scientists who followed: collaboration integrated horizontal forces; education sustained the vertical continuity of scientific work.

3. The generative logic of the "People's Scientist" spirit

Gu's scientist spirit was not a simple collection of abstract virtues. Rather, it emerged as an organic whole through the interplay of the call of the times, intellectual traditions, cultural nourishment, practical trials, and his personal life history. It represents a Chinese and contemporary expression produced through the interaction of historical, theoretical, and cultural logics.[10]

3.1. Historical logic: the unity of the call of the times and personal choice

Gu's scientist spirit was formed amid the early years of the People's Republic of China and the nationwide movement to "march toward science".[11] A series of major scientific and technological campaigns gave rise to a scientist spirit centered on patriotism, guided by dedication, and realized through collaboration and education.

When the polio epidemic erupted in Nantong, China had only a little over one hundred researchers working in virology, with very few virology laboratories, while much of infectious disease control still relied on traditional administrative and public-health measures. Gu's academic training in the Soviet Union, together with his combined training in virology and public health, made him one of the few scientists equipped to shoulder such a major responsibility. The times issued a call to a scientist who was already prepared, and he answered it with determination. His case vividly demonstrates the essential character of scientist spirit as something "rooted in specific social circumstances".[12]

3.2. Theoretical logic: the convergence of three intellectual sources

The theoretical logic underlying the formation of scientist spirit refers to the intellectual sources, value stance, and methodologies that constitute its theoretical foundation. Gu's spirit was shaped by the convergence of three major sources.

The first was the Marxist value stance that science is for the people. After entering Peking University Medical School in 1944, Gu came into contact with progressive ideas. After the founding of the People's Republic of China, the principle of "Serving the People",[13] as proposed by Chairman Mao Zedong, became the fundamental guideline for his lifelong practice.

The second was a methodology of selecting research priorities on the basis of real-world problems. He consistently adhered to an empirical mode of thinking—"starting from phenomena and relying on data"—and a problem-oriented logic: "wherever there is a problem, that is where research should be conducted." During his vaccine research, a desperate mother once carried her paralyzed child to him seeking treatment, and he could only reply painfully, "At present, we have no way to cure this disease".[4] This sense of helplessness drove him to transform the limitations of clinical treatment into a commitment to disease prevention.[12]

The third was an academic disposition characterized by independent and critical thinking. During his years of study in the Soviet Union, he trained under the virologist Mikhail Chumakov, mastered modern virological research methods, and witnessed international debates over the technical route for polio vaccination.[4] This experience strengthened his ability to resist blind deference to authority and laid the foundation for his later decision to choose the live attenuated vaccine route despite opposition.

The three sources permeated one another in practice: the people-centered value stance defined the direction of value, the problem-oriented approach determined the research pathway, and critical thinking safeguarded independent judgment. Together, they formed the deep theoretical foundation of Gu's scientist spirit.

3.3. Cultural logic: the cultivation and enrichment of the humanistic spirit

The formation of Gu's spirit cannot be separated from the influence of China's outstanding traditional culture. Traditional values such as the pursuit of knowledge through the investigation of things, innovation, and practical usefulness were compatible with scientific values, while collectivism and a sense of responsibility toward family and nation helped shape his inner world.[14]

The family maxim he passed on to later generations—"loyalty and filial piety, benevolence and love, trust and righteousness, and harmony and peace"[5]—also illuminates this cultural inheritance. "Loyalty" and "trust" were embodied in his forty-year commitment to a promise, maintained at risk of his own life; "benevolence" and "righteousness" were expressed in his willingness to test the vaccine on himself and his child, echoing the traditional ethic of extending care from one's own children to the children of others. His simple remark, "If my own child does not take it and I make someone else's child take it, that would be unrighteous,"[5] represents a plain modern scientific expression of the traditional virtue of yi, or righteousness.

At a deeper level, Gu's practical disposition of "bending down toward the ground" was rooted in the traditional ideal of "practical knowledge of managing state affairs": knowledge should serve the state and improve people's lives. His decision to leave clinical medicine for public health and move his entire family to Yunnan was a vivid enactment of traditional sentiments of responsibility to the nation and family within modern public health. These cultural genes shaped his personality through his formative environment, together creating the cultural soil of his character and becoming a deeply internalized source of motivation.

4. Conclusion

Four decades devoted to a single cause, Gu transformed the scientist spirit of patriotism, innovation, truth-seeking, dedication, collaboration, and education into concrete life practice. Moreover, he embodied qualities that go beyond the standard framework: his compassion as a physician provided an emotional foundation for his actions; his commitment to grounding science in people's everyday lives reflected his belief that the ultimate purpose of science was to improve people's lives; his willingness to assume personal risk led him to test the vaccine on his own child;[5] his lifelong commitment to a single cause constituted the most authentic connotation of the "People's Scientist."

What Gu left behind was not merely a small sugar pill, but a spiritual paradigm of "using science to safeguard life". The sugar pill protected tens of millions of Chinese children and offered Chinese experience to the global effort to eradicate polio. The inclusion of commemorative activities marking his centenary in the United Nations Educational, Scientific and Cultural Organization (UNESCO)'s series of commemorations stands as an international tribute to a scientist who made meaningful contributions to medicine, the people, the nation, and humanity.

Today, global polio control still faces significant challenges, and the task of building a global community of health for all remains arduous. The essence of scientist spirit lies in responding to the call of an era with one's life and answering people's suffering with professional expertise within concrete historical circumstances. Gu's choice to respond to human suffering through public health remains a guide for generations of researchers to come.

CRediT authorship contribution statement

Xing-Yu Liu: Writing – original draft, Investigation. Jing Liu: Writing – review & editing, Project administration. Xin-Qing Zhang: Conceptualization, Supervision.

Declaration of generative AI and AI-assisted technologies use

During the preparation of this work, the authors used large language models to assist with language editing and translation. After using this tool/service, the authors closely reviewed and edited the content as needed and take full responsibility for the final content of the publication.

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