Theoretical Commonalities Between Socialism and Genetics: A Contradiction Theory Perspective

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Abstract

The historical misconceptions surrounding the "Lysenko Affair" have long obscured the intrinsic connection between socialism and genetics, with existing research predominantly focusing on their conflicts. This paper, centered on the law of the unity of opposites, combines literature review and interdisciplinary analysis to demonstrate their unity across four dimensions. The universality and particularity of contradictions form a shared logical starting point; the dialectical relationship between internal and external causes constitutes a common driving force for development; the law of transformation of contradictions establishes a shared practical pathway; the principal and secondary aspects of contradictions form a common logic for value optimization. The root cause lies in their shared adherence to objective laws serving human welfare. This research fills the gap of "prioritizing practice over theory", provides support for resolving the "opposition between science and ideology", and offers guidance for ethical regulation of gene technology and socialist governance.

Keywords

Socialism, Genetics, Law of the unity of opposites, Dialectical materialism

Introduction

During the 1930s to 1960s, the Lysenko affair in the Soviet Union forcibly tied Lamarck's pseudoscience of "heredity of acquired characteristics" to socialist politics. It was precisely this ideological coercion that led to the widespread formation of the cognitive bias that "socialism and genetics are inherently opposed" within both academic circles and the general public. This deviation disregards the essential attributes of socialism - rooted in dialectical materialism as its philosophical foundation - and genetics - centered on revealing the objective laws of life. Consequently, the academic community has long failed to conduct in-depth exploration of their theoretical connections. This has fostered a one-sided understanding of their relationship and creating obstacles at the logical starting point for subsequent related research [1].

Existing research has largely focused on either the policy support for genetics in socialist countries or the application of genetic technologies within socialist practices. Examples include China's participation in the Human Genome Project and the use of crop genetics and breeding to bolster food security. However, these studies have not addressed the core theoretical resonance between the two. Particularly in the analysis of the core principle of dialectical materialism - the "law of the unity of opposites" - there exists a significant gap. This gap has neither elucidated the law's shared guiding value for socialist practice and genetic research nor revealed the intrinsic theoretical compatibility between the two based on this law. This deficiency perpetuates the myth of "science versus ideology" and urgently requires systematic research to address.

The theoretical significance of this study lies in establishing the law of contradiction and unity as the shared theoretical foundation for socialism and genetics.

It enriches the Marxist perspective on science and technology and deepens understanding of the dialectical relationship between science and ideology. Moreover, it breaks free from binary oppositional thinking.

Its practical significance lies in providing methodological guidance for ethical regulation of contemporary gene-editing technologies. It helps constrain the misuse of Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology through socialist collectivist principles. At the same time, it infuses socialist governance with systems thinking and leverages genetic systems theory to optimize social governance structures. The study employs two methodologies: (1) A literature review approach, systematically examining key works of dialectical materialism - such as *On Contradiction* - alongside core texts in molecular genetics and epigenetics to extract critical theoretical connections between the two fields. (2) An interdisciplinary analytical method integrates sociological interpretations of socialist development patterns with life sciences' insights into genetic evolutionary principles. This method reveals the concrete manifestations and inherent consistency of contradiction theory across both domains.

The universality and particularity of contradictions: A shared logical starting point

Socialist practice: Commonality and individuality

The practice of socialism centers on the core principle of the dialectical unity of commonality and individuality. It upholds the essential attributes of socialism - such as public ownership of the means of production and people's sovereignty - while exploring differentiated pathways tailored to the specific conditions of each country [2]. Among these, the commonality centers on safeguarding people's interests and pursuing social equity as core objectives, serving as the fundamental guiding principle for practice. Individuality, determined by each nation's historical traditions, resource endowments, and developmental stage differences, provides the concrete foundation for realizing these shared goals. In practice, China's socialist market economy with Chinese characteristics both adheres to the universal principle of "market-determined resource allocation". At the same time, it adapts to the uneven development of productive forces in the primary stage through government macro-regulation. For instance, China's gross domestic product (GDP) increased from 3.679 trillion yuan in 1978 to 126.050 trillion yuan in 2023. This leap was driven by this institutional adaptation.

The adaptation allows the economy to balance market forces with state intervention. Within the common framework of "universal healthcare coverage", Cuba leverages its concentrated medical resources and well-developed public services to establish a "universal free genetic counseling" model. This model achieves the integration of common objectives with specific needs.

Genetic research: Patterns and adaptation

Genetic research operates on the core principle that "universal laws guide specific practices". It builds its foundation on the universality of cross-species genetic mechanisms while designing protocols tailored to the unique characteristics of each research subject. Core mechanisms such as deoxyribonucleic acid (DNA) replication and transcription exhibit cross-species consistency. For instance, humans and fruit flies share approximately 60% homologous genes, providing a basis for model organism research. Genetic characteristics vary across species and individuals, necessitating tailored research approaches. For example, research on the mouse p53 gene has revealed the mechanisms of human tumor suppressor genes. This has led to the development of breast cancer screening protocols targeting specific mutations in the human breast cancer 1 (BRCA1) gene. Crop breeding not only follows the principles of genetic recombination. It also employs differentiated strategies tailored to the characteristics of rice and wheat, such as indica-japonica hybridization and the introduction of rust-resistant genes.

Dialectical resonance: Methodological unity

Socialist practice and genetic research resonate profoundly in their grasp of the universality and particularity of contradictions. This resonance is centered on a dialectical methodology that "takes universal principles as its foundation and concrete contexts as its focal points". Both approaches take universal cognitive principles as their logical premise. The essential attributes of socialism and the core

mechanisms of genetics respectively constitute the "common benchmarks" within their respective fields. These ensure that practice and research remain aligned with their fundamental direction. The value of personalized exploration lies in adapting universal principles to specific conditions. Whether it's the socialist market economy with Chinese characteristics adapting to national conditions, or crop breeding adapting to species characteristics. Both are essentially practices of "analyzing specific contradictions in specific contexts". This approach avoids both the "dogmatism" of detaching from reality and the "fragmentation" of deviating from fundamental laws. This dialectical logic of "setting direction through commonality while pursuing effectiveness through individuality" is the key to sustaining vitality in socialist practice [3]. It also serves as the core methodology for genetics to overcome technical bottlenecks. This demonstrates the cross-disciplinary theoretical penetrating power of the law governing the universality and particularity of contradictions.

Dialectical relationship between internal and external factors: A shared driving force for development

Socialist development: Synergy of internal and external factors

The development of socialism is driven by internal contradictions within society as its primary cause and external conditions as secondary factors. It advances social progress through the dialectical logic that "internal causes determine the essence, external causes facilitate progress, and external causes exert influence through internal causes". Internal contradictions serve as the fundamental driving force of development.

For instance, the mismatch between productive forces and production relations directly determines the core direction of progress. External conditions provide the necessary support for development, yet their impact can only be realized through internal reforms.During China's reform and opening-up, the internal factor was the constraints imposed by the planned economy on productive forces. The external factor was the flow of technology and capital brought about by globalization.

By adjusting production relations through the household contract responsibility system and market economy reforms, China activated its internal factors of production. At the same time, by introducing foreign capital and advanced technology to leverage external factors, the country ultimately achieved a leap in productive forces. In the new era of rural revitalization, internal factors include imbalances in rural industries and talent shortages. Meanwhile, external factors encompass the proliferation of digital technologies and urban-rural integration policies. By cultivating new professional farmers to strengthen internal factors and leveraging rural e-commerce to harness external factors, we can drive improvements in the quality and efficiency of the rural economy. This fully demonstrates the synergistic effects of internal and external drivers [4].

Genetics: Gene-environment interaction

In genetics, the expression of biological traits and evolution follow the principle that genes serve as internal factors and the environment as external factors. This adheres to the pattern: "Genes determine potential, environment shapes expression, and external factors exert influence by regulating internal factors". Genes constitute the core determinant of a trait's essence; the potential range of core traits such as height and disease susceptibility is genetically determined. The environment provides the conditions for trait realization and exerts its influence by affecting gene expression. In human height genetics, genes such as fat mass and obesity-associated protein (FTO) and high mobility group AT-hook 2 (HMGA2) serve as internal factors that define the potential height range. Environmental factors like childhood nutrition and exercise intensity act as external factors, regulating the expression of these genes to guide height toward the upper or lower limits of this potential range [5].

Epigenetic studies further validate this logic, demonstrating that environmental factors such as diet and psychological stress can regulate gene expression through DNA methylation and histone modifications. For instance, early childhood trauma leads to increased methylation of the nuclear receptor subfamily 3 group C member 1 (NR3C1) gene (glucocorticoid receptor gene). Furthermore, by acting on endogenous factors, it suppresses gene expression, which increases the risk of anxiety disorders in adulthood by 2.3 times, clearly illustrating the interactive mechanism between internal

and external factors [6].

Dialectical resonance: Unified mechanism of action

The development of socialism and genetic research form a profound resonance in the dialectical relationship between internal and external factors, centered on a unified methodology. This methodology states: "Internal factors determine the fundamental direction, external factors assist in unleashing potential, and external factors must act through internal factors." Both theories center on "internal factors" as the core pillar of development: In socialism, internal social contradictions determine the essence of societal progress; in genetics, genes determine the fundamental biological traits. The value of external factors lies in providing conditions to activate internal factors, not in replacing them. In terms of their operational pathways, socialism follows a distinct logic.

External factors like globalization and policy must drive development. They do so through internal mechanisms such as adjusting production relations and cultivating endogenous capabilities. In genetics, environmental factors like nutrition and stress must influence traits by regulating the internal mechanism of gene expression.

Both approaches reject both "external determinism" and "internal isolationism". This cross-disciplinary mechanism unifies both the universality of the dialectical materialist principle of internal and external causes and the theoretical compatibility between the two.

The law of contradiction transformation: A shared path of practice

Socialist practice: Transformation of contradictions and conditions

The practice of socialist reform centers on "actively creating conditions". Through interventions such as policy adjustments and institutional improvements, it drives the transformation of social contradictions toward directions conducive to development. Contradictions in social development - such as those between poverty and development, or efficiency and equity - are not fixed. The key to their transformation lies in establishing suitable conditions that propel opposing sides from antagonistic to cooperative relationships. China's poverty alleviation efforts serve as a prime example. The contradiction between poverty and development once hindered rural progress. The targeted poverty alleviation policy fostered distinctive economies through industrial support and enhanced employment capabilities via skills training. These became the core drivers of this transformation. Through purposeful interventions that created development opportunities for impoverished groups, nearly 100 million rural residents were lifted out of poverty by 2020. This ultimately resolved the contradiction between "poverty" and "development" [7]. In the socialist market economy, the tension between "efficiency and equity" is similarly balanced through the creation of conditions. For example, progressive personal income tax rates are implemented to regulate income distribution. The nationwide coordination of basic pension insurance is advanced to strengthen social security. Together, the tax and social security systems serve as the conditions that drive the shift from "efficiency first" to "balancing efficiency and equity". This shift thereby safeguards harmonious social development.

Genetics: Transformation and regulation of contradictions

Genetic research and applications pursue the path of "technological intervention or environmental regulation". They transform detrimental genetic traits into advantageous ones by creating necessary conditions, thereby achieving optimization of biological functions or species improvement. The transformation of contradictions at the biological genetic level involves examples such as disease-causing genes versus normal physiological functions, and low-yield traits versus high-yield demands. It relies on precise interventions targeting genes or the environment. These interventions drive the resolution of contradictions toward outcomes that align with desired requirements.

The therapeutic breakthrough in sickle cell anemia demonstrates the role of technological innovation in enabling treatment. This disease is caused by pathogenic mutations in the hemoglobin subunit beta (HBB) gene. The core issue is the contradiction between "abnormal hemoglobin synthesis" and "normal physiological function". CRISPR-Cas9 gene editing technology serves as the transformative condition. By editing the disease-causing gene in the patient's hematopoietic stem cells, it repairs the abnormal HBB gene to a normal

state, achieving the transition from "abnormal synthesis" to "normal synthesis". Crop breeding and environmental regulation follow the same logic. Addressing the contradiction between low and high yields, corn's high-photosynthetic-efficiency genes are introduced into rice via gene transfer technology. This creates optimized photosynthetic conditions. These conditions drive the transformation of low-yield traits into high-yield traits. Simultaneously, regulating temperature to suppress Arabidopsis Flowering Locus C (FLC) gene expression creates flowering conditions. These conditions convert "late-flowering traits" into "early-flowering traits". This adaptation meets planting cycle requirements [8].

Dialectical resonance: Unified pathways of transformation

Socialist practice and genetics resonate profoundly with the law of contradiction transformation. At their core, both actively intervene to create targeted conditions. These conditions propel contradictions toward resolutions conducive to achieving objectives. This adheres to the dialectical logic that "contradiction transformation depends on specific conditions". The transformation pathways of the two belong to the realms of social sciences and life sciences respectively, yet their underlying logic is consistent.

Socialism relies on policy and institutional frameworks as conditions for transformation, while genetics depends on technological environments. Both achieve precise interventions to circumvent the randomness of natural evolutionary contradictions, ensuring the direction of transformation aligns with human needs.

Socialism pursues social progress, while genetics strives for the optimization of life. From the perspective of targeted transformation, socialism designs policies to address specific contradictions such as poverty and inequity - for instance, targeted poverty alleviation addresses poverty. Similarly, genetics develops technologies to tackle specific contradictions like disease-causing mutations and low-yield traits - such as CRISPR targeting HBB gene mutations.

Both embody the transformation principle of "addressing specific contradictions with specific solutions". This unification of paths not only validates the universality of the law of contradiction transformation but also further highlights the inherent alignment between socialism and genetics in theoretical methodology.

Contradictions in primary and secondary aspects: Shared values and optimization

Socialist practice: Adjustment of primary and secondary contradictions

Socialist practice achieves precise alignment between resource allocation and the people's interests and needs by dynamically focusing on the principal aspect of the principal contradiction. During the primary stage of socialism, China centered its efforts on "economic development" to address the primary contradiction between "the people's material needs and backward production". This approach propelled GDP from 3.679 trillion yuan in 1978 to 126.050 trillion yuan in 2023. Consequently, it fundamentally resolved material shortages. In the new era, the focus has shifted to "high-quality development", tackling the challenge of unbalanced development through initiatives such as rural revitalization and the dual carbon goals. In the public service sector, Cuba prioritizes "basic healthcare" as the cornerstone of universal health coverage, achieving a life expectancy of 79.3 years. It has also established specialized research centers to develop precision treatments for sickle cell anemia. Vietnam, meanwhile, has made "agricultural modernization" its foremost priority, boosting grain production from 20 million tons in 1986 to 47 million tons in 2020. Concurrently, it has developed light industry to build an integrated industrial-agricultural system [9].

Genetic research: Primary factors and optimization

Genetics achieves research objectives through the logic of "prioritizing breakthroughs in major effectors while utilizing minor effectors for auxiliary optimization". In human disease research, targeting the Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) gene as the core intervention for cystic fibrosis, CRISPR-Cas9 technology alleviates disease symptoms in mouse models. Concurrently, integrating the minor effector gene solute carrier family 26 member 9 (SLC26A9) further enhances therapeutic efficacy [10].

In crop breeding, during periods of food shortages, efforts focused on major yield genes such as rice Gn1a

and Dense and Erect Panicles 1 (DEP1), leading to the development of "super rice" that increased yield per mu from 357 kilograms to 513 kilograms. Subsequent research shifted toward enhancing "quality and stress tolerance". It focused on cultivating high-quality, stress-resistant varieties. These varieties were centered on the Wx gene (responsible for amylose content) and the Pyricularia oryzae resistance 9 (Pi9) gene (resistance to rice blast disease) [11].

Dialectical resonance: The unity of values and pathways

Socialism and genetics achieve a dual unity in value orientation and optimization pathways through their grasp of primary and secondary contradictions. At the value level, socialism centers on "maximizing people's interests". It directs resources toward critical areas like poverty alleviation and grassroots healthcare. Genetics, in contrast, focuses on "life health and food security", concentrating on major effect genes to address disease prevention and crop yield enhancement. Both adhere to the rational principle of "achieving maximum benefits with minimal resource input".

At the pathway level, both dynamically adjust their primary and secondary priorities. Socialism has shifted from "prioritizing economic construction" to "prioritizing high-quality development". Genetics, meanwhile, has transitioned from "yield gene research" to "stress-resistant gene research". Typical examples include China advancing its dual carbon goals centered on "green energy development". Genetics focuses on the "drought-resistant gene dehydration-responsive element-binding protein 1A (DREB1A)". Both efforts aim to address climate change. Both demonstrate the practical logic of "focusing on the core while considering coordination".

Conclusion

This study employs the law of the unity of opposites as its core analytical framework to systematically reveal the intrinsic theoretical commonalities between socialism and genetics. It addresses the existing research gap characterized by an overemphasis on practical applications at the expense of theoretical resonance. It provides a systematic argument to resolve the myth of "science versus ideology" sparked by the Lysenko affair. The findings demonstrate that socialism and genetics - though belonging to the realms of social science and life science, respectively - exhibit four dimensions of profound alignment. This alignment is situated within the methodological framework of dialectical contradiction theory. The universality and particularity of contradictions are unified. This unity forms their shared logical starting point.

The unity of the dialectical relationship between internal and external causes constitutes their common developmental driving force. The unity of the law of contradiction transformation defines their shared practical pathway. The unity of the principal and secondary aspects of contradictions establishes their common logic for value optimization. This theoretical commonality stems from both disciplines sharing the fundamental goal of "adhering to objective laws and serving human welfare". Future research may integrate emerging fields such as synthetic biology and epigenomics. This would further explore the empirical manifestations of contradiction theory in gene module design and long-term gene-environment interactions. Such exploration would thereby enrich the theoretical common ground. Simultaneously, it should advance the translation of theory into practice.

For instance, it should construct ethical regulatory frameworks for gene editing technologies based on the principle of primary and secondary aspects of contradictions. Or it should optimize socialist governance by drawing on genetics' logic of "gene-environment synergy". This interdisciplinary theoretical resonance can serve the development of science and technology ethics and the modernization of social governance. The revelation of this theoretical commonality also validates the cross-domain universality of the dialectical materialist methodology. It thus provides crucial methodological guidance for the coordinated development of science, technology, and society in the new era.

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Conflicts of Interest

The authors declare no conflict of interest.

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