Academic Education Publishing House

Philosophy and Social Science Vol. 2 No. 11, 2025

From Cognitive Mapping to Cultural Symbolism: A Multidisciplinary Review of Plant Metaphor Research

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Abstract: Research on plant metaphors explores how individuals conceptualize abstract experiences through the cognitive, aesthetic, and cultural dimensions of botanical imagery. This multidisciplinary review synthesizes existing scholarship from cognitive linguistics, literature, scientific modeling, and socio-cultural studies to elucidate the transdisciplinary mechanisms by which plant metaphors generate meaning. Grounded in Conceptual Metaphor Theory, the study examines how plants serve as source domains, mapping biological characteristics onto human cognition and cultural expression. The synthesis reveals that plant metaphors function as cognitive structures that facilitate universal comprehension while simultaneously reflecting distinct cultural identities. Specifically, the review highlights their diverse roles: promoting philosophical reflection in literature, structuring theoretical frameworks in scientific discourse, and fostering ecological stewardship in socio-cultural contexts. Crucially, the paper addresses the dual nature of these metaphors, which serve as creative bridges but can also impose cognitive constraints or lead to misunderstandings in science communication and translation. Ultimately, this article identifies plant metaphors as vital intermediaries between natural experience and human cognition, offering a unified framework for future interdisciplinary research.

Keywords: Plant Metaphor; Cognitive Linguistics; Cultural Symbolism; Interdisciplinary Study; Conceptual Metaphor Theory

1. Introduction

Traditional views, exemplified by Aristotle, define metaphor as a linguistic figure of speech that consists of "giving the thing a name that belongs to something else." In the 1980s, Lakoff and Johnson innovatively proposed the theory of conceptual metaphor in their book *Metaphors We Live By*, defining metaphor for the first time as a fundamental cognitive tool for human understanding of the world, a one-way mapping from a source domain to a target domain [1]. Thus, metaphor functions both as a literary device and as a pervasive way of thinking and a cognitive phenomenon. Among diverse metaphor types, plant metaphors stand out as a unique and significant category. Closely intertwined with human existence and rich in cultural resonance, they have drawn considerable scholarly attention, becoming a subject of enduring academic discourse.

The examination of plant metaphors is of considerable significance, seen in three principal dimensions. First, plant metaphors exhibit universality. As a primary source of sustenance and shelter, plants are fundamental to human survival. Consequently, people have accumulated comprehensive and profound knowledge about plants' appearance, form, and growth habits, providing a shared empirical ground for cross-cultural metaphor comprehension. Second, plant metaphors have profound cultural significance. They embody profound memories of farming civilization, religious belief, and philosophical history [2], forming a complex cultural symbol system. Finally, plant metaphors demonstrate interdisciplinary applicability. From cognitive linguistics' mapping mechanisms to literary aesthetic expression, from scientific explanation to social-cultural education, plant metaphors exhibit multifaceted functions and values across disciplines and fields, serving as bridges that connect diverse knowledge domains.

Existing research indicates that contemporary studies on plant metaphors exhibit distinct interdisciplinary characteristics. While different

disciplines demonstrate varying interpretations and applications of plant metaphors, all highlight their potent cognitive and cultural expressive functions. Linguistic research emphasizes the cognitive patterns and cross-cultural comparisons of plant metaphors, revealing their systematic role in conceptual mapping. Literary studies underscore their aesthetic and philosophical value, focusing on imagery and spiritual symbolism. Scientific research focuses on its modeling role in explaining complex phenomena. At the same time, social-cultural studies examine their social functions in shaping social and cultural perspectives, as well as the cultivation of ecological consciousness. Such diversity reflects the rich functionality of plant metaphors, but it also highlights challenges stemming from the lack of multifaceted discussion and research integration. This limitation is also evident in current classification approaches, where scholars categorize metaphors either by disciplinary field or functional dimension, yet they lack a unified framework that integrates multidisciplinary perspectives. Therefore, this paper aims to break down disciplinary barriers by systematically examining key issues of plant metaphors across four major domains: cognitive linguistics, literary poetry, scientific medicine, and social-cultural studies. It aims to examine potential avenues for dialogue among these disciplines and to identify possible methods and insights for developing a cohesive analytical framework that incorporates cognitive, symbolic, and practical functions. This endeavor aims to provide new perspectives for understanding ecological culture and the relationship between humanity and nature.

2. Cognitive Linguistic Foundations of Plant Metaphor

2.1 Theoretical Foundation: Conceptual Metaphor Theory

First proposed by Lakoff and Johnson in the 1980s, Conceptual Metaphor Theory marked the beginning of systematic studies of metaphor in cognitive linguistics, overturning the long-held view that metaphor serves merely as rhetorical decoration. Conceptual Metaphor Theory posits that metaphor is a fundamental cognitive mechanism through which humans understand the world. At its essence is cross-domain mapping, the methodical comprehension of an abstract, intricate target domain, such as life or social phenomena, by utilizing a concrete, tangible source domain, such as the growth cycle of plants.

The effectiveness of this mapping largely depends on the perceptible similarity between the source domain and the target domain [3]. It is precisely this similarity-based connection that enables concepts from different domains to be interrelated [4]. Moreover, conceptual metaphors exhibit systematicity and coherence. Different metaphors are not isolated linguistic phenomena but form coordinated expression systems centered around core concepts [1].

Nevertheless, this mechanism itself contains a specific paradox. While metaphors improve cognitive efficiency, they may also limit human viewpoint. For example, the metaphor ARGUMENT IS WAR reveals the strategies and antagonism inherent in debate while obscuring the cooperative and constructive potential of argumentation, where the goal of both participants is to come to an agreement [5]. This theory provides a solid foundation for research on plant metaphor, enabling us to understand the generative logic and cognitive functions of plant imagery in language and culture from a cognitive perspective.

2.2 Cognitive Mechanisms: From Conceptual Systems to Meaning Networks

2.2.1 Definition of plant metaphor

Within human language and cultural systems, *plants* have long served as highly experiential cognitive resources. Due to their close association with human life experiences, they are frequently employed as the source domain for metaphors. Definitions of plant metaphors vary significantly depending on disciplinary perspectives. From a cognitive linguistics perspective, the plant metaphor is a cognitive tool that utilizes the life characteristics, morphological structures, and growth cycles of plants as the source domain to understand abstract concepts, such as human life or social phenomena [1].

Building upon this theoretical framework, scholars in both Chinese and Western contexts have systematically interpreted Chinese plant metaphors. Natural processes such as plant growth, flowering, fruiting, and withering are mapped onto the human life journey, giving rise to expressions like *he is in the prime of his youth* and *a hero in his twilight years* [4,6].

This definition suggests that plant metaphors are cognitive-linguistic phenomena that connect the conceptual domains of *plants* and *humans* by similarity.

Building upon this foundation, research has delved deeper into the internal mechanisms of metaphorical mapping. Luo analyzing *Dream of the Red Chamber*, refined the mapping mechanism into cross-domain mapping, inferential mapping, and latent mapping [7]. The study also identified the synergistic interaction of four key elements of plant metaphors: the source domain, the target domain, the base experiential, and the mapping. Research findings demonstrate that plant metaphors are not only straightforward one-to-one correspondences; they also involve more complex relationships. Rather, they build multi-level cognitive networks that utilize components such as plant characteristics and life cycles to map individual physiologic qualities, social standing, and even destiny. This illustrates the intricacy and depth of their cognitive abilities.

Thus, the core contribution of cognitive linguistics lies in revealing the universality and systematic nature of plant metaphors as fundamental cognitive tools for humanity, providing a crucial theoretical foundation for understanding the relationship between language, thought, and culture. Building on this, we need to examine the cognitive mechanisms underlying plant metaphors more closely, particularly how this system constructs meaning networks at higher levels to achieve semantic dynamics and cultural adaptability.

2.2.2 Multidimensional cognitive mechanisms of plant metaphors

From a linguistic and cognitive perspective, plant metaphors are fundamentally conceptual mappings, cognitive processes that enable the understanding of abstract concepts through transformations between source and target domains. The diverse plant metaphors in everyday language actually originate from a deep conceptual system, whose surface diversity reflects two key characteristics: systematicity and complexity [8].

The systematic character of plant metaphors is indicative of the cognitive principles that regulate their development process. For instance, the mapping process of the metaphor IDEAS ARE PLANTS strictly follows the life cycle of plants, from *seeds of thought* to *sprouting*, *flowering*, *and fruiting*, forming a clear and predictable cognitive chain. This mapping structure is not only embedded in fixed linguistic collocations but also reflects the stability and productivity of the cognitive system, ensuring efficiency and consistency in metaphor generation and comprehension. This systemic nature constitutes the structural foundation of plant metaphors as a cognitive framework.

The complexity of plant metaphors manifests as a multidimensional and multilayered network of meanings. Their mapping process is bidirectional, encompassing both assimilation metaphor, where PEOPLE ARE PLANTS, and borrowed metaphors, where PLANTS ARE PEOPLE, creating rich semantic interactions [4]. Moreover, this metaphorical network unfolds sequentially from the *whole plant* to its *parts* and then to its *life cycle*, with each layer corresponding to distinct social, cultural, and individual meanings [7]. Thus, plant metaphors are not static conceptual mappings but rather a multi-layered, expandable system of meaning.

Furthermore, the cognitive mechanisms of plant metaphors exhibit significant dynamism and context dependency. Depending on the context, a single plant image, like *flower*, might have both positive and negative implications. In patriarchal societies, for example, it may have fixed meanings like *women are like flowers* or *vines without support*. As eras shift and emotional tensions evolve, these metaphorical meanings undergo dynamic reconfiguration, exemplified by the flourishing of *vivid colors* versus the wilting of *withered flowers and broken willows*. Cross-cultural transformations reveal the interactive nature of cognition and culture [9]. This semantic fluidity reflects the ongoing reconstruction and renewal of plant metaphors within social contexts.

In summary, the cognitive mechanism of plant metaphors can be viewed as a multilayered structure spanning from conceptual systems to semantic networks: its systematic nature ensures the predictability and structural stability of cognitive mapping, while its complexity, dynamism, and context-dependence endow this system with generativity and cultural vitality. It is precisely within this dialectical unity of *system-network* that plant metaphors reveal cognitive depth, transcending linguistic and cultural boundaries, and serving as a crucial window for understanding the Chinese way of

thinking and its cognitive systems.

2.3 Universality and Cultural Differences

Cognitive linguistics posits that plant metaphors represent a universal cognitive strategy through which humans grasp abstract concepts by drawing on familiar experiences. They enhance communication efficiency by enabling listeners to intuitively grasp plant characteristics or human traits through two cognitive mechanisms: associations based on morphological and functional similarities, and inferences grounded in cultural consensus.

Plant life cycles, such as growth, thriving, wilting, and withering, represent universal human experiences, which is why they serve as the cognitive basis for conceptual metaphors such as PEOPLE ARE PLANTS. Consequently, similar expressions often exist across languages. For instance, the Chinese phrase *hanbao daifang* (budding) and the English phrase *a budding youth* both use the early stages of plant growth to metaphorically describe human youth, reflecting cognitive universality.

However, within this universal cognitive framework, cultural factors lead to variations in specific metaphors. For instance, while both Chinese and English use plants to symbolize life, their imagery choices and connotations differ [6]. In Chinese, the metaphor of *roots* (*gen*) is intricately associated with ancestry, lineage, and one's homeland, embodying a family-oriented understanding of identity. Conversely, English *roots* emphasize cultural heritage and personal affiliation rather than lineage, frequently manifesting in phrases like *go back to one's roots* or *put down roots* [10]. The Chinese proverb *luoye guigen* (leaves fall back to their roots) implies that individuals return to their hometowns in old age [11], illustrating how *roots* represent family and origin. In Western sociological discourse, *roots* often metaphorically relate to collective trauma and cultural belonging [10]. Similarly, Confucian culture endows plum blossoms, orchids, bamboo, and chrysanthemums with noble virtues. The orchid, together with the plum blossom, chrysanthemum, and bamboo, is called the "Four Gentlemen" (*si junzi*) and symbolizes the virtues of a scholar. Just as plum flowers, orchids, bamboo, and chrysanthemums represent the virtues of scholars in Chinese culture, Western civilizations similarly employ plants to convey moral attributes. The *oak* has historically been viewed as an emblem of strength, resilience, and valor [12]. Its metaphorical significance is intimately linked to perseverance and ethical strength. Aligned with the Confucian ideal of the scholar-gentleman represented by the "Four Gentlemen," this botanical imagery also constitutes a symbolic framework in Western culture for conveying ethical attributes.

This phenomenon demonstrates that plant metaphors are products of the interaction between universal cognitive patterns and specific cultural contexts. They reflect both cross-linguistic commonalities in thought and profound differences in values, historical allusions, and aesthetics across cultures, offering significant insights for intercultural communication studies. These cognitive and cultural differences are most vividly manifested in cross-linguistic translation practice.

2.4 Challenges in Translation and Dissemination

In the translation and dissemination of plant metaphors, assimilation metaphors and borrowing metaphors represent the two most prevalent categories [4]. The former projects human characteristics onto plants based on similarity, capturing readers' interest while facilitating understanding of the referenced plants through association and inference. The latter projects analogous plant traits onto humans to vividly depict physical appearance, personality, status, and more. These expressions render plant metaphors highly effective communication tools.

However, the deep cultural imprint embedded within plant metaphors poses significant challenges in cross-cultural translation and communication. Constrained by the target culture's symbolic systems, aesthetic conventions, and reception contexts, the aesthetic resonance and philosophical significance of source-language metaphors are highly susceptible to loss or misinterpretation when lacking equivalent associative foundations in the target culture.

The translation process of *Dream of the Red Chamber* precisely reveals this dilemma. Expressions in Chinese, such as *shallow roots* or *a century to nurture a person*, carry cultural connotations, where roots symbolize family background and trees represent education, which lack direct equivalents in languages like

Spanish. Improper handling easily dilutes the original text's aesthetic and philosophical significance, leading to metaphorical loss or cultural misinterpretation. In the face of this cultural-symbolic mismatch, removing the imagery would compromise the integrity of the original text. The method of cultural substitution, combined with compensatory footnotes, is more effective in promoting the target culture's acceptance of the translation [7].

Moreover, plant metaphors are often deeply intertwined with specific cultural values. For instance, Chinese and Korean proverbs use *flowers* and *grass* to metaphorically represent women, with their positive or negative connotations reflecting differing cultural valuations of female roles. This particularly challenges translators' cultural sensitivity during translation. Thus, the translation of plant metaphors hinges on striking a balance between cognitive salience and the degree of cultural adaptation. Between languages with vast cultural differences, the possibility of fully preserving complex metaphorical networks is minimal, and some loss of imagery is inevitable. Thus, literary translation practice is essentially a delicate balancing act: translators must retain the most salient metaphors while modifying or omitting elements prone to misunderstanding to achieve the most ideal artistic effect in the target text.

Overall, research on the translation of plant metaphors reveals the interplay between cognitive similarities and cultural differences, offering new perspectives for cross-linguistic understanding. Current studies remain predominantly focused on Chinese-English comparisons, with insufficient exploration of other languages and multicultural contexts. Future research could deepen the study of the mechanisms of plant metaphor dissemination from an interdisciplinary perspective, opening broader horizons for literary and cultural studies. While linguistic and cognitive research has uncovered the systematic foundations of plant metaphors, their true aesthetic and philosophical potential is most fully realized in literary and poetic creation.

3. Plant Metaphors in Literature and Poetry: Aesthetics and Symbolism

In literary studies, plant metaphors transcend mere cognitive categories, evolving into a mechanism for artistic expression that integrates aesthetic value, symbolic function, and philosophical significance. They serve not only as vehicles for emotional experience and spiritual pursuit but also constitute a core pathway for image generation and meaning construction in literary works. The inherent nature of plants, grounded in the earth while reaching toward the sky, makes them an ideal artistic vehicle for expressing humanity's dual existence of finitude and transcendence [13]. In poetry and narrative texts, plant imagery creates an aesthetic space that bridges natural experience and metaphysical speculation through vivid narratives of growth, wilting, and regeneration. This reveals the triple core of literary metaphor: aesthetic figuration, cultural symbolism, and philosophical speculation.

3.1 Prototype Structure and Cultural Symbolism

The symbolic function of plant imagery is first manifested at the prototype level. As prototypes, plants often represent the origin, growth, death, and rebirth of life, themes profoundly reflected in numerous classics of world literature. Through the metaphorical use of plants, authors express their understanding and contemplation of nature, life, and human destiny.

Current scholarship reveals that the *Tree of Life* in the Bible is likely one of the most famous tree metaphors [2]. In Western tradition, Plato's *Inverted Tree* symbolizes the soul's ascent and transcendence, while the *Tree of Life* in the Bible serves both ethical and theological functions, acting as a symbolic mediator between humanity and divinity, as well as between finitude and eternity. As Brown [14] argues, the *Tree of Life* in biblical texts embodies not only theological redemption but also an ecological affirmation of non-human life. Eastern literature, meanwhile, uses the cyclical growth of plants to reveal the logic of life's cycles and the tragic awareness of existence. In *Dream of the Red Chamber*, the imagery of *Daiyu Burying Flowers* uses the blooming and wilting of flowers to metaphorically represent the rise and fall of families and the impermanence of individual destinies, forming a symbolic system where the life cycle of plants mirrors the vicissitudes of human existence [7]. These cross-cultural textual traditions demonstrate that plant metaphors not only carry the sensory dimension

of natural imagery but are also internalized as a shared cultural memory within human civilization concerning the order of life and the cosmos.

3.2 Poetic Expression and Philosophical Deepening

While this prototype function remains relatively static within classical texts, it finds its most profound and dynamic philosophical application in the creation of poetry. In the realm of poetry, the life cycle of plants serves as a concentrated embodiment of the philosophical questions of human existence: birth, death, and the possibility of transcendence.

Korean modern poetry illustrates vertical transcendence. In Korean modern poetry, Kim Hyun-seung, Park Mok-wol, and Ra Tae-joo map spiritual journeys through plant growth, where plant metaphors serve as a bridge connecting nature and the soul. Kim Hyun-seung employs dual symbolism through *ascending* and *descending* botanical imagery: germinating branches and new green leaves reaching upward represent the desire to "transcend the physical body and return to the source," while falling leaves and seeds descend, completing the transcendence "from death to life" through "death—returning to the earth" [13]. As a Christian poet, his works often present prayers and devotion to God in a solemn tone. In autumn, a season of special significance in his creative process, he immerses himself in religious belief. The crow imagery in his works symbolizes his religious soul. His mid-career religious doubts stemming from Christianity's inherent limitations, coupled with his late-life return to absolute faith after confronting death, added a religious-philosophical dimension to the spiritual essence of his plant metaphor [15].

Unlike Kim Hyun-seung's multidimensional expression, Park Mok-wol focuses on the posture of trees "grounded in the earth yet reaching toward the sky," shifting the plant metaphor from landscape depiction to expressing an existential consciousness of self-transcendence. Through the trajectory of *grounded-ascending* and *sourness-maturity*, he transforms earthly introspection into an aspiration for eternal life, converting human finitude into an "upward eternal movement," achieving a dual transcendence of aesthetics and philosophy [16]. Conversely, Ra Tae-joo observes plants with a "downward gaze." His progressive imagery, evolving from *grass flowers* to *trees* and *dandelions*, corresponds to life's fragility, growth, and transcendence, marking a leap from compassion for others to self-transcendence [17]. These works highlight the unique value of plant metaphor: they resonate with natural cycles while symbolizing the regeneration and transcendence of the human spirit.

In contrast to the vertical spiritual transcendence in Korean poetry, Su Shi's verse presents a horizontal philosophy of time. Using the life cycle of plants as a metaphor, he constructs an isomorphic relationship between human life and nature, integrating Confucian aspirations for progress, Daoist notions of cyclicality, and Buddhist concepts of emptiness [18]. He symbolized political disillusionment through the drifting *willow catkins*, while resolving the dichotomy of prosperity and decline with the phrase "no wind, no rain, no sunshine," which revealed the dialectical unity of time and existence. Within his poetic system, plant imagery, such as *fallen blossoms* and *evergreen pines*, not only embodies personal ideals and life's resilience but also serves as the symbolic core where aesthetic experience and philosophical reflection intertwine. Su Shi employs plant imagery to transform natural experiences into philosophical metaphors about life, time, and destiny, thereby creating a cognitive framework mediated by plants. Plant metaphors thus integrate spiritual connotations across both vertical (transcendence) and horizontal (journey) dimensions, revealing poetry's profound cognitive function in interpreting human life experience. Consequently, plant metaphors in poetry achieve a dual reconstruction of aesthetics and philosophy, while providing a symbolic and analytical framework for understanding cross-cultural cognitive differences.

3.3 Symbolic Systems and Cultural Reflection

From mythic archetypes to poetic expression, the role of plant metaphors in literature reveals a continuous evolution from cultural memory to speculative symbolism. Their symbolic significance extends beyond the representation of natural life, reflecting humanity's cognitive endeavors to reconcile cosmic order with

individual experience. As a cultural symbol system, plant metaphors actively participate in the construction of meaning and the reproduction of values, serving as a dual mechanism for aesthetic creation and philosophical reflection in [17]. In this sense, plant metaphors not only provide a symbolic structure that transcends language and culture but also become a key pathway for literature to understand human existence.

The plant metaphor in literature stands in stark functional contrast to the modeling mindset in scientific fields. Compared to the *soft* applications in literature that emphasize aesthetics and philosophical reflection, plant metaphors in science exhibit *hard* functions such as constructing theories and explaining models. However, both fundamentally share the same cognitive function: understanding abstract and complex phenomena through the process of concretization. This cross-disciplinary metaphorical thinking offers a new theoretical perspective for exploring the cognitive interplay between literature and science.

4. Plant Metaphor in Science: Models, Paradigms, and Dissemination

Within scientific and medical contexts, plant metaphors serve as cognitive and linguistic structures that exhibit distinct dual properties: they function as foundational tools for comprehending complex phenomena and constructing theoretical models, yet may also constrain thinking and foster misunderstandings. By projecting plant growth patterns, structural features, or interactive logic onto scientific objects, metaphors provide visual cognitive frameworks for complex phenomena. However, when metaphors evolve from explanatory tools into theoretical models or communicative vocabularies, their epistemology undergoes a significant shift, accompanied by tensions between cognitive potential and inherent risks [19,20].

4.1 Theoretical Models and Enlightenment Tools

Within scientific research, the primary function of plant metaphors lies in their capacity to visualize and structure complex phenomena. A prime example is the *Tree of Life* metaphor. Initially presenting species differentiation visually, it was later mathematized and formalized in systems biology, evolving into a computable phylogenetic tree that became a central tool for evolutionary analysis and taxonomy [19]. This transformation illustrates how metaphors transition from cognitive aids to foundational frameworks for theoretical construction.

Plant metaphors possess dual dimensions of explanatory and heuristic functions. The explanatory function is manifested through analogies to plant morphology and tissue structures, lending a concrete expression to abstract concepts. For instance, likening gene networks to *root systems* helps reveal hierarchical relationships and interaction patterns within complex systems. Its heuristic function manifests as a mechanism for generating hypotheses. For instance, the field of Plant Neurobiology leverages metaphors of plant *sensing* and *signaling* to stimulate research on plant decision-making and information processing mechanisms [20].

Nonetheless, as a heuristic instrument for researchers, it has cognitive dangers in addition to its ability to inspire scientific creativity. When metaphors are misconstrued as factual, they might shift from cognitive tools to epistemological constructs. For instance, directly reifying the *nervous system* metaphor onto plant systems risks obscuring fundamental structural and functional differences between the two. Furthermore, the *Tree of Life* metaphor may distort models when confronting reticulate evolutionary phenomena, such as horizontal gene transfer, prompting scholars to advocate for supplementing it with *network* metaphors. Similarly, introducing social-cultural terms like *gender* into plant sex research, while enriching analytical dimensions, risks introducing cultural biases and misleading inferences [21].

Thus, plant metaphors in scientific modeling should be understood as controlled cognitive tools: their heuristic value depends on clearly defined semantic boundaries. Metaphorical applications within science must remain open and reflective, fully leveraging their inspirational function while remaining vigilant against potential cognitive limitations, avoiding the slide from explanatory frameworks into reified dogma.

4.2 Metaphors and the Evolution of Scientific Paradigms

Beyond its specific explanatory functions, the plant metaphor has profoundly shaped the formation and historical evolution of scientific disciplines at a macro level. The hierarchical system of 17th-century plant taxonomy

provided a reference framework for psychiatric and medical diagnosis, transforming disease descriptions from empirical accounts into systematic classifications. The 19th-century evolutionary *tree-ecology* metaphor further shifted disease concepts from static to dynamic models.

The choice of metaphor itself can even signal a scientific revolution. In the mid-19th century, Darwin's replacement of prevailing *network* or *ladder* metaphors with the one-way branching *tree* marked a pivotal step in establishing the new scientific paradigm of evolution. This symbolized the theoretical reconstruction of evolutionary theory and laid the foundation for the systematic thinking patterns of modern life sciences [19]. Today, the revival of the *web* metaphor to challenge the *Tree of Life* can be seen as a potential paradigm shift in its own right. Here, metaphor serves not merely as a rhetorical device in scientific language but as a cognitive trigger for paradigm renewal: it participates in the reorganization of knowledge systems through adjustments in representational modes.

These cases demonstrate that scientific metaphors not only reflect but actively shape the intellectual climate and disciplinary trajectories of specific eras. The function of plant metaphor in science extends far beyond mere explanation; they are deeply embedded in the historical construction of knowledge systems. Through the transfer of figurative structures, they drive the reconfiguration of conceptual frameworks and the redrawing of theoretical boundaries [21]. When this shaping force extends from within science into the broader public sphere, it enters the vast domains of social-cultural and educational contexts. The risks primarily stem from semantic overextension and anthropomorphic misinterpretation.

4.3 The Double-Edged Sword of Science Communication

As plant metaphors extend from scientific applications to public communication, their value and controversies become more pronounced. Metaphors like the *Mother Tree* and *Wood Wide Web* significantly enhance public understanding of ecological complexity and interdependence by endowing forest ecosystems with relational and social characteristics [22]. Such metaphors play a positive role in science education and ecological communication, enabling the widespread dissemination of specialized knowledge through vivid imagery.

However, this communication carries risks of anthropomorphism and emotionalization. When the emotional and moral implications of metaphors are heightened, scientific concepts may undergo semantic reinterpretation. For instance, the media portrays the *Mother Tree* as a nurturing entity *caring for* saplings and depicts forests as *social organisms* possessing will and moral attributes. This blurs the boundary between science and narrative, extending beyond empirical research. Research indicates that overly anthropomorphic narratives may lead the public to form views of nature based on emotional resonance rather than empirical evidence [22].

Thus, plant metaphors in science communication harbor an inherent contradiction: they serve as pathways for knowledge dissemination while simultaneously posing potential sources of misdirection. Empirical and review studies on metaphors in environmental and climate communication demonstrate that various metaphor types, specifically concrete versus systemic metaphors and emotional metaphors, differ in their effectiveness for improving understanding and motivating action. Furthermore, the excessive use of metaphors can lead to misinterpretation or emotional responses [23]. Effective communication must establish a dynamic equilibrium between comprehensibility and precision, avoiding semantic slippage by clearly delineating the boundaries of metaphorical rhetoric. The inspirational value of scientific language must be grounded in conscious awareness of metaphorical cognition [20]. The risks of metaphor in science communication also mirror cognitive limitations within science itself, as both demonstrate how metaphor simultaneously serves dual functions of interpretation and constraint within the scientific knowledge system.

5. Plant Metaphor in Socio-Cultural Contexts: Narrative and Practice

While literary studies focus on the *symbolic-aesthetic* function of plant metaphors, scientific discourse emphasizes their *model-explanatory* role, and social-cultural analysis centers on how metaphors serve as *cognitive frameworks* and

practical resources that directly engage with and shape collective experiences and behaviors. In social-cultural and educational contexts, plant metaphors transcend mere rhetorical devices. They function as cognitive structures and pragmatic tools that significantly impact the development of collective identity, emotional articulation, and ecological awareness. Their functions span disease narration, economic discourses, and educational practices, demonstrating the adaptive and operational value of metaphors in social cognition and behavior.

5.1 Illness Narratives and Emotional Healing

Within disease narration, plant metaphors construct shared cognitive frameworks enabling individuals and groups to comprehend and articulate complex life experiences while participating in identity formation [24]. Cancer patients and their families often describe the disease journey using plant growth cycles: the initial diagnosis is likened to *a storm of life breaking young seedlings*, treatment is understood as the *grounded phase*, and recovery is visualized as *regeneration of dead branches*. Such metaphors transform abstract disease experiences into tangible life processes, aiding patients' emotional adjustment while facilitating effective doctor-patient communication.

Healthcare providers can alleviate patient anxiety by using plant metaphors to explain pathological mechanisms, such as tumor growth patterns. Simultaneously, when clinicians understand and respond to patients' metaphors, communication efficiency and trust significantly improve. Family members also employ imagery, such as *sprouting* and *wilting*, to express concerns and hopes for life. Parents of pediatric patients, in particular, convey recovery expectations through phrases like *the seed sprouting anew*, reflecting their understanding of and cooperative attitude toward the medical process [24].

Thus, plant metaphors serve multiple functions in disease narration, including medical explanation, emotional expression, and psychological support, revealing the adaptive and practical value of metaphor as a cognitive tool within specific social contexts. This finding aligns with existing research on climate communication metaphors, suggesting that high-emotion metaphors can increase anxiety and feelings of helplessness, whereas structured, process-oriented metaphors enhance understanding and promote a willingness to act [25].

5.2 Cognitive Framework of Economic Discourse

In economic contexts, plant metaphors also possess powerful cognitive explanatory power. The metaphor comparing economic processes to the plant growth cycle (*seed, sprouting, growth, flowering, fruiting, wilting*) serves as a structural cognitive tool. For instance, *seed capital* corresponds to a company's startup phase, *sprouting* signifies rapid expansion, *blossoming* symbolizes market prosperity, *reaping benefits* represents profit realization, while *withering* metaphorically denotes decline or bankruptcy [26].

By analogizing complex economic phenomena to biological life cycles, such metaphors facilitate understanding and communication while establishing a linear, predictable developmental logic within economic narratives. Their universality and cognitive efficacy not only reveal the operational mechanisms of metaphor in economic thinking but also provide systematic theoretical tools for analyzing economic discourse. Studies on social policy and resource governance indicate that metaphors can shape frameworks and guide actions within public decision-making narratives. The *flow-life-cycle* metaphor in water resource governance has a significant impact on policy formulation [27].

5.3 Education and Ecological Consciousness Formation

While science communication (as discussed in 4.3) risks misinterpretation, educational practices intentionally leverage plant metaphors to shape ecological ethics and identity. Plant metaphors not only construct cognitive frameworks within social and cultural contexts but also play a central role in shaping ecological ethics and environmental consciousness. By analogizing plants as *kin* or *teachers*, linguistic metaphors establish an ethical community between humans and nature [28], significantly enhancing individual ecological care within educational and public narratives. For instance, the Plant Love Stories project demonstrates that plant metaphors can increase public willingness to participate in nature conservation [29]. Cognitive experiments further confirm that

plant vocabulary correlates with traits like *nurturing* and *fragility*, guiding the unconscious formation of ecological responsibility [30]. In educational and cultural transmission practices, plant metaphors serve multi-level ecological education functions, from cognitive enlightenment to value shaping, through classroom analogies [31] and material cultural symbols, such as Iraq's *Tree of Life* architecture [32]. Through cognitive, emotional, and cultural symbol mechanisms, plant metaphors embed ecological consciousness into social practice, providing a solid foundation for environmental education and research in ecological ethics.

From emotional anchors in disease narratives to framework construction in economic discourse and ethical shaping in ecological education, plant metaphors demonstrate potent practical functions across social and cultural domains. Although these applications appear fragmented, their essence can be traced back to the concept mapping of cognitive linguistics and the symbolic construction of literary poetry. Therefore, future research should not focus on compiling more examples but rather on reverse-engineering these social practices to understand how they refine and supplement existing theories in cognitive science and literature.

6. Conclusion

Plant metaphors act as essential mediators between natural experience and human cognition, exhibiting multidimensional functions across cognitive linguistics, creative poetry, scientific modeling, and social practices. This review demonstrates that while plant metaphors are grounded in universal biological life cycles, their specific manifestations are profoundly shaped by cultural and disciplinary contexts. The cross-domain analysis reveals a critical paradox: while metaphors serve as powerful heuristic tools for scientific modeling and social framing, they carry inherent risks of epistemological bias and cultural misinterpretation, exemplified by anthropomorphic tendencies in science communication and semantic loss in cross-cultural translation. Therefore, a holistic approach is required to navigate these challenges. Future research should move beyond fragmented case studies to investigate the systemic mechanisms of metaphor adaptation. Priority should be placed on the ethical implications of ecological narratives and strategies for preserving metaphorical richness in translation. Ultimately, integrating these diverse perspectives not only deepens our understanding of the nexus between language, mind, and nature but also provides a theoretical foundation for fostering a more resilient ecological consciousness in an increasingly globalized world.

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