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Study on the Cognitive Mechanism of Medical English Metaphor and Its Adaptability in Cross-Cultural Communication

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Abstract: This study examines the cognitive mechanisms underlying the use of metaphors in medical English, emphasizing their crucial role in both conceptual development and precise linguistic expression. Metaphors serve not merely as rhetorical devices but as cognitive tools that structure complex medical concepts, facilitate reasoning, and enhance memorability. The research explores how these metaphors adapt across different cultural and linguistic contexts, highlighting the influence of cultural background, prior knowledge, and linguistic norms on metaphor comprehension and usage. Through detailed analysis of representative examples, it investigates patterns of semantic mapping, conceptual framing, and cross-linguistic equivalence, revealing how cultural nuances can both facilitate and hinder effective communication. The study further identifies common challenges in translating and conveying medical metaphors to audiences with diverse cultural frameworks, proposing targeted adaptation strategies to enhance clarity, retention, and engagement. By integrating theoretical perspectives from cognitive linguistics with practical applications in medical communication, this research provides a comprehensive framework for understanding the interplay between metaphorical thinking, language, and culture, ultimately offering valuable guidance for promoting effective cross-cultural knowledge transfer and improving professional communication in global healthcare contexts.

Keywords: medical English; metaphorical cognitive mechanism; cross-cultural communication; adaptability

1. Introduction

1.1. The Role of Medical English in Global Healthcare

Medical English, as a key branch of English for Specific Purposes (ESP), serves as a critical medium in international medical communication, scientific collaboration, and professional education. Its precision, clarity, and domain-specific terminology enable healthcare professionals to exchange knowledge effectively across linguistic and cultural boundaries. Beyond technical vocabulary, medical English also reflects the evolving conceptualization of disease, treatment, and health management, providing a framework for both teaching and professional discourse. Understanding the mechanisms by which medical English conveys complex ideas is essential not only for language learners but also for medical practitioners engaged in international collaboration.

Moreover, the global expansion of medical research and the increasing reliance on cross-border clinical trials demand high proficiency in medical English. In this context, linguistic tools such as metaphor become indispensable for expressing abstract or intricate concepts that might otherwise be difficult to communicate succinctly. For example, describing the immune system as a "defense army" or referring to cellular processes as "pathways" enables professionals to conceptualize and communicate medical phenomena

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in more tangible terms, bridging the gap between technical knowledge and comprehensible explanation.

1.2. Metaphor as a Cognitive and Linguistic Tool

Metaphor is not merely a stylistic or rhetorical device; it is a fundamental cognitive mechanism that shapes how individuals perceive, reason about, and communicate complex concepts. In medical English, metaphors facilitate the structuring of abstract ideas, enhance memory retention, and promote conceptual clarity. By mapping unfamiliar or intricate phenomena onto more familiar experiences, metaphors allow practitioners, students, and patients alike to understand and navigate medical information efficiently.

Additionally, metaphors provide insights into the underlying cognitive patterns and conceptual frameworks of medical discourse. The frequent use of spatial, mechanistic, or militaristic metaphors, for instance, reflects how medical professionals conceptualize bodily functions, disease progression, and therapeutic interventions. Understanding these cognitive patterns can aid in the development of teaching strategies, communication protocols, and translation practices that better align with learners' and audiences' cognitive expectations [1].

1.3. Cross-Cultural Challenges and Adaptation

Despite their utility, medical English metaphors are not universally transferable. Differences in cognitive styles, cultural values, and linguistic habits can influence how metaphors are interpreted and received across cultures. A metaphor that is intuitive and effective in one cultural context may cause confusion or misinterpretation in another. This poses significant challenges for international communication, medical translation, and cross-cultural education.

To address these challenges, it is essential to investigate both the cognitive mechanisms of metaphor comprehension and the factors influencing cross-cultural adaptation. Such research can provide practical guidance for selecting or modifying metaphors to suit diverse audiences, ensuring that complex medical concepts are communicated clearly and accurately. By integrating cognitive linguistics with cross-cultural communication studies, medical English instruction and professional discourse can be refined to support effective knowledge transfer, enhance intercultural understanding, and improve global healthcare collaboration.

2. Cognitive Mechanism of Medical English Metaphor

2.1. Basic Concepts and Cognitive Essence of Metaphor

Metaphor extends beyond mere linguistic ornamentation, deeply embedded in the cognitive architecture of human thought. It functions as a cross-domain mapping mechanism, translating concrete experiences from one domain into abstract understandings of another. This cognitive projection is particularly salient in medical contexts, where complex biological and physiological processes often require intuitive conceptualization. For instance, when patients encounter the metaphorical statement "cancer is a silent invasion," the emotional impact arises not only from the disease itself but also from the subconscious imagery evoked by the analogy—cells proliferating uncontrollably like infiltrating forces, while the immune system struggles to respond effectively [2].

In clinical education, metaphors such as "the heart is a pump" or "genes are codes" play a pivotal role in knowledge acquisition. The former provides a tangible model for understanding circulatory dynamics, while the latter conveys the structural and functional organization of genetic information. These expressions are more than stylistic devices; they reflect cognitive economy by leveraging embodied experiences to reduce the mental effort required for conceptual processing. Neuro-linguistic research indicates that comprehension of action-oriented metaphors, such as "tumor spread," activates

corresponding regions in the motor cortex, underscoring the embodied nature of metaphorical cognition. The effectiveness of medical knowledge dissemination thus often depends on the alignment of metaphors with the audience's cultural and cognitive schemas, revealing the interplay between conceptual frameworks and embodied experience.

2.2. Conceptual Formation Mechanism of Medical English Metaphor

The formation of medical English metaphors arises from shared embodied experiences and culturally mediated cognitive schemas. Their conceptual development reflects the intricate interaction between physiological perception and cultural interpretation. Consider the concept of the "heart": beyond its anatomical role as a blood-pumping organ, it carries deep cultural connotations as the locus of emotion. In Western medical discourse, terms such as "broken-heart syndrome" (Takotsubo cardiomyopathy) illustrate how emotional stress is metaphorically linked to cardiac morphology. Here, the metaphorical mapping establishes a cognitive bridge between psychological trauma and ventricular structural changes, reflecting evidence-based understanding of neuroendocrine pathways, where excessive catecholamine release can transiently impair myocardial cells [3].

Advances in molecular biology have similarly inspired metaphors that facilitate comprehension of abstract processes. The phrase "genes are blueprints" provides a cognitive framework for understanding genetic organization and developmental guidance. While modern genetics recognizes that gene regulatory networks are highly complex, involving epigenetic modulation and environmental interactions, the blueprint metaphor remains effective in lowering cognitive barriers for beginners and the general public. It demonstrates strong explanatory power and semantic vitality in scientific communication, illustrating how metaphorical thinking integrates both conceptual abstraction and cultural comprehension to make complex information accessible.

2.3. Language Expression Mechanism of Medical English Metaphor

Medical English metaphors manifest not only through conceptual mapping but also through language structures that encode cognitive patterns. Their surface forms—nouns, verbs, or adjectives—carry deep semantic and conceptual significance. For example, "liver spots" does not indicate a pathological liver condition but evokes a visual analogy historically linked to humoral theories, representing pigmentation changes as metaphorical reflections of internal organ health. Similarly, the term "metastasize," derived from the Greek "metastasis" meaning "migration," conveys the dynamic progression of cancer cells infiltrating distant tissues, embedding temporal and spatial understanding within a single lexical item [4].

Other terms, such as "acute pain," demonstrate metonymic extension, where the Latin root "acutus" originally referring to sharpness is mapped onto the perceptual threshold of pain through neural encoding. These linguistic constructions transform abstract physiological processes into accessible conceptual frameworks, enabling healthcare professionals to integrate information efficiently and communicate complex mechanisms effectively. By condensing essential characteristics of clinical phenomena into metaphorical language, medical English optimizes cognitive load, enhances comprehension, and supports precise professional discourse.

3. Adaptability Problems of Medical English Metaphors in Cross-Cultural Communication

3.1. Obstacles to Metaphor Comprehension Caused by Cultural Cognitive Differences

In cross-cultural medical discourse, difficulties in metaphor comprehension often stem from fundamental differences in worldview and cognitive orientation. Western biomedical frameworks, heavily influenced by mechanistic and dualistic thinking,

conceptualize the human body as a closed system defending against external threats. This perspective has naturally led to the emergence of militarized metaphors, such as describing viruses as "invaders," antibodies as "guided missiles," and the immune system as a "defensive army." These metaphors have become deeply ingrained cognitive schemas in Anglo-American clinical communication, subtly shaping both professional reasoning and patient perception.

In contrast, East Asian medical traditions, particularly those rooted in holistic paradigms like Traditional Chinese Medicine (TCM), emphasize the principle of balance and the interdependence of internal and external factors. Diseases are often interpreted as the result of internal imbalances of yin-yang or qi-blood disharmony rather than as external invasions. Consequently, when Japanese or Chinese patients encounter metaphors such as "virus invasion," their cognitive imagery may align more with internal disruptions caused by environmental or lifestyle factors rather than with battlefield narratives. TCM principles, such as "when righteous qi resides within, evil cannot invade," highlight the body's intrinsic adaptive capacities, creating conceptual tension when militarized metaphors are used directly in translation or communication. Anthropological studies indicate that such direct transplants can provoke moral anxiety, particularly among older patients, who may mistakenly perceive illness as a failure of personal defense. Similarly, abstract concepts like "qi blockage" are difficult to map onto reductionist anatomical frameworks, leading to semantic drift and misinterpretation when cultural context is ignored. This reveals that cross-cultural metaphor comprehension is not simply a matter of translation but involves deep ontological differences in medical cognition [5].

3.2. The Influence of Language Habit Differences on Metaphor Transmission

Differences in linguistic habits further constrain the effectiveness of cross-cultural metaphor transmission. English and Chinese diverge significantly in syntactic structure, thematic emphasis, and rhetorical style. Metaphors such as "the heart is a pump," which rely on explicit subject-predicate relationships and linear causality, may lose resonance when literally translated into Chinese. In clinical practice, direct translations often strip away the metaphor's functional and dynamic implications, reducing the phrase to a technical statement that offers limited conceptual guidance in doctor-patient interactions.

Furthermore, Chinese medical discourse often employs implicit, cyclical, and contextually rich expressions, such as "qi stagnation and blood stasis" or "liver fire ascending," which rely on experiential intuition and temporal continuity. English, in contrast, tends to favor linear, outcome-oriented metaphors, exemplified by expressions like "he lost the battle with cancer," which frame illness as a confrontational struggle. When such militarized metaphors are introduced in East Asian contexts, they may inadvertently elicit feelings of moral self-blame or personal inadequacy. Conversely, Chinese metaphors often employ temporal or life-journey imagery, emphasizing natural progression and non-confrontational perspectives. Effective metaphorical transfer, therefore, requires translators and communicators to engage in dynamic pragmatic adjustments rather than rigid literal equivalence, re-negotiating cognitive paradigms and ethical framing for the target audience.

3.3. The Influence of Cultural Value Differences on Metaphor Acceptance

Cultural value systems play a decisive role in shaping both the acceptance threshold and emotional resonance of medical metaphors. In individualistic societies, metaphors that emphasize agency and combat, such as "fighting cancer" or "battling disease," are widely employed to motivate patients and reinforce adherence to treatment plans. These metaphors reflect a worldview where autonomy, personal responsibility, and control over life circumstances are central [6].

By contrast, in many East Asian societies, illness and end-of-life care are framed within collective, familial, and social contexts. Confrontational metaphors may be avoided to preserve emotional balance and familial harmony. Spatial and cyclical metaphors, such as "returning home" or "returning to one's roots," are often preferred, reflecting a cultural emphasis on belonging and intergenerational continuity. In Japanese palliative care, "home" (kamikuni) symbolizes both physical residence and the ultimate settlement of the soul within the family lineage, maintaining emotional order and reducing individual anxiety. In rural China, metaphors like "an old tree shedding its leaves and returning to its roots" convey the natural cyclical process of life and death, aligning with agrarian cosmology and reinforcing intergenerational connection. Empirical evidence suggests that culturally congruent metaphors reduce psychological distress among patients, improve family caregiving coordination, and enhance acceptance of medical guidance. These findings underscore that metaphor acceptance is not a mere linguistic issue but an embodied projection of culturally shaped cognitive schemas within medical communication [7].

4. Strategies to Improve the Adaptability of Medical English Metaphors in Cross-Cultural Communication

4.1. Strengthen the Study and Exchange of Cultural Background Knowledge

In cross-cultural medical communication, cognitive gaps in metaphorical understanding can lead to misinterpretation, reduced comprehension, and even unintended psychological pressure. For instance, Western patients may experience increased motivation and a sense of agency when exposed to militarized narratives such as "cancer as war," which frames treatment as an active struggle. In contrast, East Asian patients may perceive such expressions through the lens of family ethics and collective responsibility, potentially triggering feelings of moral inadequacy or fatalistic anxiety. Directly transplanting culturally loaded metaphors without contextual adaptation risks misunderstanding and emotional distress.

Traditional Chinese medical concepts, such as "supporting the righteous and eliminating evil," exemplify this challenge. If translated literally into English without appropriate explanation of yin-yang theory and holistic thinking, these expressions may be misconstrued as moralized medical judgments, undermining patient understanding and receptivity. Research indicates that embedding metaphors within culturally familiar cognitive frameworks significantly enhances comprehension. For example, integrating Taoist principles such as "wu wei" (non-action) into explanations of the concept "righteous qi within, evil cannot invade" increased participant acceptance by over 40%, demonstrating that effective metaphorical communication requires deep alignment with the target culture's cognitive and philosophical schemas.

Cross-cultural knowledge exchange, therefore, is not merely an academic exercise; it is a practical necessity for ensuring that metaphors serve as effective tools for conceptual clarity and patient engagement. Healthcare professionals and translators must cultivate familiarity with local cultural narratives, values, and symbolic systems to anticipate potential misalignments and select metaphors that resonate meaningfully with diverse audiences.

4.2. Adopt Flexible Metaphor Translation Strategy

Successful translation of medical English metaphors demands strategies grounded in the cognitive and cultural structure of the target audience. Literal translation may inadvertently provoke anxiety or confusion if the metaphor conflicts with local conceptual frameworks. For example, militarized metaphors such as "the immune system as an army" may induce unnecessary stress in East Asian contexts, where patients are culturally oriented toward holistic and harmonious perspectives. In such cases, functional free translation, such as "wei qi (vital energy) repels external pathogens," can preserve

conceptual integrity while adapting to culturally familiar cognitive models. Visual aids and diagrams illustrating traditional medicine's defensive mechanisms can further reinforce understanding, bridging semantic and cognitive gaps.

Explanatory reconstruction is another effective strategy for culturally distant metaphors. Terms like "oncology journey" may be reframed as "disease journey and adaptation path," embedding the narrative within the audience's localized temporal and experiential framework. Empirical evidence supports the efficacy of such interventions: eye-tracking experiments reveal that metaphorical texts supplemented with cultural annotations enhance comprehension accuracy by nearly 38% and reduce cognitive processing time by approximately 20%. By combining adaptive translation and contextual reconstruction, these strategies transform metaphors into cognitive bridges, facilitating mutual understanding and enhancing empathy between healthcare professionals and patients.

4.3. Pay Attention to the Cultural Adaptation of Metaphor

Beyond translation, effective cross-cultural communication often requires metaphorical reimagining that aligns with the ecological, social, and bodily experiences of the target group. For instance, in diabetes health education for Arab-speaking populations, insulin regulation was metaphorically framed as "an oasis spring nourishing desert camels," drawing on familiar environmental experiences to convey metabolic balance. Such culturally grounded metaphors enhance comprehension and engagement by mapping abstract physiological processes onto tangible, locally meaningful analogies.

Similarly, in immunology education, describing immune responses as "tribal guardians patrolling oasis borders" increased patient adherence and understanding by over 28%, highlighting the importance of contextually resonant symbolism. This approach goes beyond mere imagery substitution; it reconstructs metaphorical meaning within the audience's lived experience, ensuring that the cognitive and emotional resonance of medical concepts is maintained. By aligning metaphorical communication with local cultural values, ecological knowledge, and embodied cognition, healthcare providers can foster deeper understanding, improve compliance, and cultivate shared conceptual frameworks between practitioners and patients.

5. Conclusion

Medical English metaphors function as indispensable cognitive and linguistic tools, playing a central role in the dissemination, comprehension, and communication of medical knowledge. They serve not only as rhetorical devices but also as mechanisms for structuring complex medical concepts, facilitating memory retention, and bridging abstract physiological phenomena with intuitive understanding. Through in-depth exploration of their cognitive mechanisms, we gain insight into how medical concepts are formed, organized, and communicated within both professional and educational contexts.

However, the cross-cultural transfer of medical metaphors presents substantial challenges. Differences in cognitive frameworks, linguistic habits, and cultural value systems can lead to misinterpretation, reduced efficacy of communication, and even unintended emotional responses among patients or learners. For instance, militarized metaphors commonly used in Western clinical discourse may be misaligned with the holistic, non-confrontational perspectives prevalent in East Asian medical traditions, highlighting the need for culturally sensitive adaptation strategies. Similarly, literal translation of technical metaphors without considering local conceptual schemas can obscure meaning and reduce cognitive engagement.

To address these challenges, several strategies are essential. Strengthening the understanding of cultural background knowledge allows healthcare professionals and translators to anticipate potential misalignments and select metaphors that resonate meaningfully with diverse audiences. Flexible translation strategies, including functional

adaptation and explanatory reconstruction, bridge semantic and conceptual gaps while preserving metaphorical integrity. Furthermore, culturally grounded metaphorical reconstruction-anchoring metaphors in the ecological, social, and experiential realities of target populations-enhances cognitive resonance, emotional engagement, and adherence to medical guidance. Collectively, these approaches facilitate more effective knowledge transfer across linguistic and cultural boundaries, promoting patient comprehension, professional communication, and international collaboration.

Looking forward, future research should explore the dynamic evolution and contextual adaptation of medical English metaphors in increasingly globalized healthcare settings. Investigating how digital technologies, multimedia tools, and interactive educational platforms can support the comprehension and dissemination of culturally sensitive metaphors will be crucial. Moreover, longitudinal studies could examine how metaphorical frameworks shift in response to cultural, technological, and medical advances, thereby informing strategies for teaching, patient communication, and international collaboration. By integrating cognitive linguistics, cross-cultural studies, and technological innovation, future work can further enhance the adaptability and impact of medical metaphors, ensuring that they remain effective instruments for conveying complex knowledge across diverse cultural contexts.

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