

CONCEPTUAL METAPHOR THEORY: EXPLORING THE ROLE OF METAPHOR IN CONCEPTUALIZING ABSTRACT CONCEPTS

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Abstract:

We introduce Conceptual Metaphor Theory (CMT) as a framework for enhancing large language models (LLMs) through cognitive prompting in complex reasoning tasks. CMT leverages metaphorical mappings to structure abstract reasoning, improving models' ability to process and explain intricate concepts. By incorporating CMT-based prompts, we guide LLMs toward more structured and human-like reasoning patterns. To evaluate this approach, we compare four native models (Llama3.2, Phi3, Gemma2, and Mistral) against their CMT-augmented counterparts on benchmark tasks spanning domain-specific reasoning, creative insight, and metaphor interpretation. Responses were automatically evaluated using the Llama3.3 70B model. Experimental results indicate that CMT prompting significantly enhances reasoning accuracy, clarity, and metaphorical coherence, outperforming baseline models across all evaluated tasks.

Key words: Conceptual Metaphor Theory, Large Language Models, Prompt Engineering, Benchmark Evaluation, Complex Reasoning.

INTRODUCTION

Integrating insights from Conceptual Metaphor Theory (CMT), which emphasizes understanding abstract concepts through metaphorical mappings from concrete domains, offers a promising approach. By designing prompts to incorporate metaphoric reasoning, LLMs can be guided to tackle complex reasoning tasks more effectively. In this study, we propose a CMT-inspired prompt engineering strategy to enhance the reasoning capabilities of LLMs. We hypothesize that LLMs can generate more coherent, contextually rich, and insightful responses across diverse task categories using CMT-inspired prompts. We evaluate this approach on a benchmark dataset containing 100 tasks from multiple reasoning domains, including domain-specific reasoning, creative insight puzzles, and general problem-solving. Using four advanced LLMs – Llama3.2, Phi3, Gemma2, and Mistral – we rigorously assess the effectiveness of CMT-inspired prompts compared to baseline prompts in terms of accuracy, coherence, and depth of reasoning.

CONCEPTUAL METAPHOR THEORY

CMT is a foundational concept in cognitive science that explores how humans understand and process abstract concepts through metaphoric mappings from more tangible, familiar domains. Introduced by George Lakoff and Mark Johnson CMT posits that metaphors are not merely linguistic devices but cognitive tools deeply embedded in human thought and reasoning. They enable individuals to comprehend complex or abstract ideas by linking them to more accessible and experiential domains. For example, the metaphor “time is money” frames the abstract concept of time using the concrete and familiar framework of financial transactions. Central to CMT is the concept of source domains and target domains, which form the foundation of metaphorical thinking. The source domain represents a familiar, concrete concept grounded in physical experience or everyday life, such as spatial orientation, movement, or physical objects. In contrast, the target domain encapsulates an abstract, intangible idea that is often more challenging to conceptualize directly, such as emotions, time, morality, or complex systems. Through systematic mappings between these domains, specific properties, relationships, or structures from the source domain are transferred to the target domain. These mappings enable individuals to use their intuitive understanding of the source domain to make sense of abstract phenomena in the target domain.

For example, in the metaphor “time is a resource,” the source domain of resources (e.g., money or energy) lends its structure and relationships—such as scarcity, management, or expenditure—to the target domain of time. This allows people to conceptualize time as something that can be “spent,” “saved,” or “wasted,” making an abstract concept more tangible and actionable. Similarly, in the metaphor “knowledge is a journey,” the spatial and physical aspects of a journey—such as paths, destinations, obstacles, and progress—are mapped onto the process of acquiring knowledge, enabling individuals to conceptualize learning

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as a dynamic, goal-oriented activity. These mappings are not arbitrary; they are shaped by embodied experiences and cultural context, which influence how individuals and societies construct and interpret metaphors. The systematic transfer of relationships and properties from source to target domains is what makes metaphors powerful tools for learning, problem-solving, and creativity. By framing unfamiliar or abstract concepts in terms of familiar ones, metaphors provide cognitive shortcuts that reduce complexity, aid memory, and enhance communication.

This central mechanism of CMT highlights the profound role of metaphor in shaping human thought, reasoning, and language. It also serves as the basis for applying CMT to computational systems, where metaphoric mappings can be leveraged to enhance the reasoning capabilities of artificial intelligence, particularly in tasks requiring abstraction and analogical thinking.

CMT has been extensively studied across disciplines, including linguistics, psychology, and education, as a tool for enhancing human learning and problem-solving. Its influence extends to computational applications, where metaphors have been used to structure knowledge representation and reasoning in artificial systems. However, its potential remains underexplored in the realm of large language models, despite their impressive capabilities in generating human-like text.

CMT PROMPTING APPROACH

The CMT prompting approach employs structured metaphorical reasoning through CoT prompting. This method enables LLMs to systematically interpret abstract concepts (target domains) by mapping them to familiar physical experiences (source domains). By structuring the reasoning process step by step, these models emulate human cognitive patterns, enhancing their ability to generate more insightful and contextually relevant responses. The approach is configured within Ollama models, with the configured versions referred to as CMT-Llama3.2, CMT-Phi3, CMT-Gemma, and CMT-Mistral.

Inference Through Source-Target Mappings

The CMT-prompted models leverage systematic source-target mappings to interpret and explain abstract concepts. This process involves identifying a relevant source domain, transferring its properties and relationships to the target domain, and constructing a coherent explanation or solution. These mappings, integrated as CMT-prompts in an LLM-configuration process, enable the models to internalize metaphorical reasoning and apply it dynamically across tasks.

This structured mapping process follows CoT-like approach within the CMT framework, guiding the model step-by-step through conceptual associations to derive logical inferences. By explicitly encoding the reasoning steps that bridge the source and target domains, CMT-prompted models develop a more structured interpretive process, much like CoT enables stepwise problem-solving in mathematical and logical tasks.

Implementation Details

The CMT-prompted models operate with a balanced temperature parameter (temperature=0.7) to ensure a mix of creativity and coherence. The models are preconditioned with a system message that emphasizes their role as cognitive agents employing metaphorical reasoning.

The inclusion of these principles within the configuration process eliminates the need for manually crafting explicit CMT-based prompts for every task. Instead, the models are inherently capable of performing structured metaphorical reasoning, making them versatile for a wide range of applications, including problem-solving, teaching, and interpretation.

CONCLUSION

Conceptual Metaphor Theory (CMT) provides profound insights into how metaphors shape our understanding of abstract concepts. By illustrating the mappings between concrete experiences and abstract ideas, CMT reveals that our cognitive processes are deeply intertwined with metaphorical thinking. This interplay allows individuals to navigate complex notions such as time, emotions, and relationships through more familiar and tangible experiences. For instance, conceptualizing time as money not only clarifies its value but also influences behaviors and attitudes towards time management. Furthermore, CMT underscores the role of metaphors in communication and cultural expression. The metaphors we use reflect our societal values and beliefs, shaping collective understanding and discourse. For example, viewing arguments as war (e.g., "defending a point" or "attacking an opponent") not only frames the nature of debate but also affects interpersonal dynamics and conflict resolution strategies. This indicates that metaphors are not just linguistic embellishments but fundamental cognitive tools that shape our worldview.

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