



LINGUISTIC AND CULTURAL BARRIERS IN MACHINE TRANSLATION OF METAPHORS

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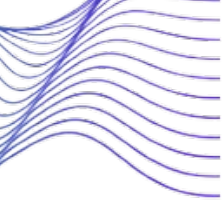
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Abstract. *Metaphors represent a complex intersection of language, cognition, and culture. Unlike literal expressions, metaphors rely on conceptual mappings that emerge through shared cultural experiences and collective knowledge. Although machine translation systems have significantly improved with the rise of neural architectures and large language models, the translation of metaphorical expressions remains a major challenge. This article explores linguistic, cognitive, and cultural barriers that complicate metaphor translation, reviews the performance and limitations of current machine translation technologies, and examines possible solutions for improving metaphor-aware machine translation. The paper also proposes research directions that could strengthen cross-linguistic metaphor processing, particularly for under-resourced languages.*

Keywords: *metaphor, figurative language, machine translation, neural MT, cross-cultural mapping, metaphor identification, evaluation*

Metaphor represents one of the most cognitively rich and culturally embedded aspects of human language. Far from being merely ornamental devices, metaphors shape how individuals conceptualize abstract phenomena, structure their experiences, and communicate complex ideas succinctly. This centrality of metaphor to human cognition has been well established in cognitive linguistics, most notably in the work of Lakoff and Johnson (1980), who argue that metaphor is fundamental to human thought rather than peripheral to language. Given this depth and complexity, the translation of metaphors—especially through machine translation systems—poses significant linguistic and cultural challenges. Although contemporary MT technologies have made enormous strides, especially with transformer-based architectures and large language models, metaphoric language remains an area in which machines frequently fail to approximate human-level comprehension and translation accuracy.

Metaphor is ubiquitous in everyday and specialized language: it facilitates conceptualization (e.g., argument is war), frames thought, and encodes cultural values (Lakoff & Johnson, 1980, Kövecses, 2002). For humans, comprehension of a metaphor depends on lexical semantics, background knowledge, and cultural convention. For MT systems, especially those trained primarily on large parallel corpora, translating metaphors reliably remains difficult because literal word correspondences often produce semantically inappropriate or opaque output. Metaphorical expressions frequently exploit polysemy (one form, multiple senses). A source-language word used metaphorically may correspond to a different lexicalization in the target language, literal transfer yields semantically odd or nonsensical phrases. Metaphors often form conventional collocations (e.g., “heavy responsibility”, “break the ice”). Collocational patterns differ across languages and may require non-compositional translations (idiomatic equivalents), which corpus-



based systems may not reliably learn when data are sparse. Many metaphors are culturally conventional (e.g., emotion is fluid in some cultures, emotion is heat in others). Mapping patterns are not universally shared, different languages may encode conceptual metaphors via different lexical or grammatical means (Kövecses, 2002).

Furthermore, metaphor is one of the most powerful, subtle, and fundamentally human features of language. Long before people learned to write or record their thoughts, they used metaphor as a tool for understanding the world around them. Metaphors allow us to express the abstract in terms of the concrete, to describe emotions as if they were physical forces, and to communicate complex ideas in vivid, memorable ways. They are deeply tied to imagination, cultural experience, social norms, and individual creativity. Because of this, metaphors present one of the greatest challenges for machine translation. While contemporary machine translation systems have made remarkable progress in producing fluent and grammatically smooth text, they still struggle profoundly with the deeper levels of meaning, cultural nuance, and symbolic associations that metaphors rely on. This essay explores why metaphor poses such a difficult problem for machines, why linguistic and cultural barriers are so intertwined, and why even the most advanced translation systems often fall short when confronted with the richness of figurative language.

One of the first obstacles lies in the very nature of metaphor itself. A metaphor is not simply a substitution of one word for another, it is a conceptual mapping between two different domains of experience. When a person says that time “flies,” they are not describing a literal process but expressing the feeling that time passes quickly and uncontrollably. To grasp this metaphor, one must understand not only the dictionary meaning of “fly” but also the experiential and cultural associations that make flight an appropriate comparison for fleeting moments. Humans make this connection almost instantly because we draw on lived experience, bodily understanding, emotions, and cultural familiarity. Machines do not have access to such experiential grounding. Instead of understanding the world through perception and feeling, machine translation systems operate through patterns, statistical associations, and large-scale text analysis. Even the most advanced systems rely on probabilities rather than genuine comprehension. Because of this, they can mimic the surface structure of language without truly grasping the conceptual mechanisms behind metaphors. This lack of understanding becomes especially problematic when a metaphor depends on multiple layers of meaning. A simple phrase – such as “grasping an idea” – requires recognizing that grasping can refer to physical holding as well as mental comprehension. While humans are adept at shifting between these two meanings, machine translation systems often default to literal interpretations when the metaphorical meaning is not strongly represented in their training data. The ambiguity inherent in metaphor is not a flaw but a feature of human expression, however, it clashes with the machine’s need for clarity and pattern consistency. Ambiguity forces the model to make a choice, and without deeper reasoning, it often chooses incorrectly.

One of the primary linguistic challenges involves the system’s inability to correctly identify metaphorical language. Because metaphors often employ conventional lexical items in syntactically ordinary contexts, distinguishing literal from figurative meaning



becomes a non-trivial problem for MT systems. For example, the English expression “grasp the idea” uses the verb *grasp* in a figurative sense, yet without broader discourse cues, a machine may interpret it literally. Research by Shutova (2015) demonstrates that most MT models continue to rely heavily on distributional patterns, which cannot always distinguish between literal and metaphorical usages, particularly in low-frequency or novel metaphoric constructions. Metaphors frequently exploit polysemy – words with multiple meanings – to generate figurative interpretations. Polysemous verbs like “break” (as in *break the silence*, *break a habit*) or nouns like “heart” (*heart of the matter*, *heart of stone*) challenge MT systems that have difficulty selecting the metaphorically appropriate sense. Although neural networks can learn contextual embeddings that somewhat mitigate this issue, they still tend to default to the statistically dominant meaning, leading to mistranslation or semantic flattening (Nakov et al., 2021).

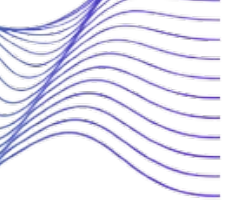
Languages often encode metaphors in structurally different ways. A metaphor in one language may rely on lexical or syntactic constructions that have no symmetrical equivalent in another. For instance, the Russian metaphor *душа ушла в пятки* (“the soul went into the heels”) expresses fear but has no direct equivalent in English. Literal machine translation produces a semantically incoherent phrase, failing to capture the affective and conceptual meaning. Newmark (1988) emphasizes that metaphor translation requires either cultural substitution or explanatory reformulation – tasks that MT systems are not generally designed to perform autonomously. While linguistic complexity presents significant challenges, cultural barriers can be even more difficult for machines to navigate. Metaphors are deeply rooted in shared cultural experiences, historical events, and symbolic systems. They often rely on associations that only make sense within a particular cultural or historical framework.

According to Kövecses (2010), different cultures prioritize different conceptual metaphors based on geography, environment, traditions, and worldview. For instance, English and many European languages use vertical orientation metaphors (*up is good*, *down is bad*), while some Indigenous languages conceptualize time, space, or emotion through entirely different spatial orientations.

A machine lacking cultural grounding might translate the metaphor “*high spirits*” literally for a language that does not use vertical height to represent positive emotional states. Symbols such as animals, colors, and natural elements often carry specific metaphorical significance within a culture. The owl symbolizes wisdom in the West but is associated with misfortune in some Middle Eastern cultures. A metaphor involving an owl would therefore evoke entirely different associations depending on cultural context.

MT systems rarely possess symbolic-cultural knowledge and often translate symbolic metaphors literally, risking misinterpretation. Many metaphors become culturally meaningful because they refer to historical events. Expressions like “*the Iron Curtain*”, “*crossing the Rubicon*,” or “*the American melting pot*” carry deep historical or ideological resonance. Without historical context, MT cannot recognize these expressions as metaphors, resulting in literal and sometimes misleading translations.

The conceptual metaphor theory asserts that metaphors are grounded in shared embodied experiences and cultural models (Kövecses, 2010). Therefore, metaphors that seem natural in one culture may be uncommon or unintelligible in another. For example,



English frequently conceptualizes argument as war (“*She attacked my point*”), while other cultures may conceptualize conflict differently. MT systems, lacking an embedded cultural model, will often translate metaphors literally, stripping them of culturally encoded meaning. Metaphors often depend on culturally specific symbols. The English metaphor “a white elephant”- meaning an unwanted or burdensome possession – derives from specific Southeast Asian cultural practices. Without knowledge of this cultural background, an MT system cannot accurately infer its intended meaning. Similarly, animals, colors, and natural elements hold different symbolic values across cultures: the owl symbolizes wisdom in Western societies but may symbolize bad luck in others. Such symbolic divergences make culturally embedded metaphors especially difficult for machines to render across languages. Metaphors frequently encode historical or political meaning. Terms such as “the Iron Curtain” or “the Red Tape” carry strong sociopolitical associations that are not transparently communicated through literal translation. MT systems generally lack the world knowledge necessary to interpret metaphors in historical context. Without this contextual awareness, translation becomes superficial or misleading, as MT outputs tend to render these expressions word-for-word rather than as culturally loaded metaphoric units.

In addition, metaphors tied to local flora, fauna, institutions, or historical references (e.g., “glass ceiling” in Anglo contexts) may have no direct counterpart in the target culture and therefore require explanatory paraphrase or localization rather than direct translation. Metaphors carry attitudinal and affective nuance. A literal translation may preserve propositional content but lose connotation, register, or rhetorical effect, leading to miscommunication in sensitive contexts (political discourse, advertising). Early statistical and phrase-based MT systems treated metaphorical strings as co-occurring word sequences, idiomatic treatment depended on annotated parallel examples. Where parallel idiomatic equivalents were scarce, outputs tended to be literal and misleading. Transformer-based NMT models (Vaswani et al., 2017) improve fluency and context-sensitivity and may generate better paraphrases. However, NMT still struggles with low-frequency metaphorical expressions and highly culture-specific mappings, models often produce literal or plausibly fluent but semantically off translations when deep conceptual transfer is required. Interpreting a metaphor involves identifying source and target domains and producing target-language expressions that preserve intended mappings. Approaches include symbolic knowledge-based mapping, bilingual metaphor lexica, and neural techniques that learn paraphrase equivalences from aligned corpora enriched with metaphor annotations.

Although machine translation technologies continue to evolve, they remain fundamentally limited by their lack of embodied experience, conceptual understanding, and cultural awareness. They can analyze vast quantities of text, detect patterns, and produce grammatically correct sentences, but they do not feel, imagine, or perceive the world as humans do. This gap is most evident when machines attempt to translate metaphors, which rely on the very aspects of human cognition that machines cannot replicate. Even large language models, despite generating remarkably natural text, often reveal their limitations when faced with metaphors that are deeply contextual, culturally loaded, or emotionally nuanced. Their translations may appear fluent but fail to capture



the metaphor's deeper meaning, symbolic value, or aesthetic quality. Nevertheless, progress continues as researchers explore new ways to improve the translation of figurative language. Some approaches involve incorporating cultural knowledge bases or cognitive models, while others focus on training systems on metaphor-rich corpora. There is also growing interest in multimodal learning, which exposes machines to images, sounds, and movements in addition to text, allowing them to form broader associations. While promising, these approaches are still in early stages and cannot yet replicate the full depth of human metaphor comprehension.

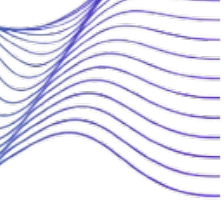
Ultimately, the challenge of translating metaphors with machines exposes a profound truth about language: it is not merely a system of rules and words but a living expression of human thought, culture, and imagination. Machine translation systems can assist with the literal backbone of language, but they struggle with its spirit. Metaphors, with their layered meanings and cultural richness, show us where the boundary between human understanding and artificial processing still lies. Until machines can experience the world, share cultural memories, or interpret emotional nuance in the way humans do, metaphor will remain a domain where human insight is indispensable. For now, the translation of metaphors reminds us not of what machines can do, but of what only humans can.

Integrating metaphor-aware constraints into decoding - e.g., forcing idiomatic candidates when a metaphor is detected, or using back-translation to validate sense preservation - has shown promise in reducing literal mistranslations. Evaluation and resources Robust evaluation requires metaphor-sensitive metrics and test suites covering conventional, novel, and culture-specific metaphors. Resources include MIPVU-annotated corpora and specialized bilingual collections assembled for metaphor translation tasks. Human evaluation remains essential to assess connotation and pragmatic adequacy.

Metaphor translation continues to challenge machine translation systems due to complex interactions between linguistic structure, cognitive conceptualization, and deep cultural meanings. While modern neural models have made notable advances, they still lack the cultural grounding, contextual awareness, and metaphor-specific processing capabilities required for human-like translation. Addressing these challenges will require interdisciplinary collaboration between computer scientists, linguists, and cultural theorists. Continued research in cognitive linguistics, metaphor annotation, and culturally informed embeddings holds promise for more accurate and culturally sensitive MT in the future. Translating metaphors reliably requires both linguistic insight and culturally informed strategies. Advances in contextual embeddings and NMT architectures improve surface fluency but do not eliminate the need for explicit modeling of conceptual mappings and culture-specific knowledge. Progress will depend on annotated resources, evaluation frameworks, and hybrid systems that combine statistical learning with symbolic cultural knowledge.

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