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LINGUO-CULTURAL AND COGNITIVE-PRAGMATIC TRANSFORMATIONS IN NEURAL MACHINE TRANSLATION (NMT) AND POST-EDITING BETWEEN UZBEK AND ENGLISH

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Abstract. Neural Machine Translation (NMT) has significantly transformed the process of translation between languages by improving fluency, contextual coherence, and lexical prediction. However, translation between Uzbek and English remains challenging because of substantial differences in linguistic structure, cultural conceptualization, pragmatic conventions, and discourse organization. This study examines linguo-cultural and cognitive-pragmatic transformations occurring in Uzbek–English NMT and investigates the role of post-editing in preserving semantic, cultural, and pragmatic equivalence. Particular attention is paid to culturally marked expressions, politeness strategies, metaphorical constructions, idioms, address forms, modality, and context-dependent meanings. The analysis demonstrates that NMT systems can reproduce the general propositional meaning of source texts while simultaneously weakening culturally embedded meanings and pragmatic intentions. Human post-editing therefore remains essential for achieving contextually appropriate translation. The study proposes a multidimensional framework combining linguistic, cultural, cognitive, and pragmatic dimensions of NMT evaluation.

Keywords: Neural Machine Translation, Uzbek, English, linguo-cultural transformation, cognitive pragmatics, post-editing, translation equivalence.

Introduction. The rapid development of artificial intelligence has fundamentally changed contemporary translation practices. Neural Machine Translation (NMT), based primarily on deep learning architectures, has become one of the dominant approaches to automated translation. Unlike traditional rule-based and statistical systems, NMT processes linguistic sequences through neural architectures capable of modeling contextual relationships across relatively large textual units [1, pp. 1–15]. The development of the Transformer architecture further strengthened this tendency by introducing an attention-based mechanism that enables models to identify relationships between linguistic elements more effectively [2, pp. 5998–6002]. Despite these technological advances, machine translation cannot be considered a purely linguistic process. Translation involves the transfer of meanings that are embedded in particular cultural, cognitive, and pragmatic environments. As Baker emphasizes, equivalence in translation must be examined at different levels, including lexical, grammatical, textual, and pragmatic dimensions [3, pp. 5–8]. This issue becomes particularly important when translating between Uzbek and English, two languages belonging to different linguistic traditions and characterized by distinctive cultural conventions.

Uzbek is a Turkic language with predominantly agglutinative morphology, relatively flexible word order, extensive use of honorific and respectful forms, and culturally specific phraseological expressions. English, in contrast, has a comparatively analytic grammatical structure and employs

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different mechanisms for expressing politeness, modality, definiteness, and interpersonal relationships. Consequently, direct linguistic correspondence does not always guarantee pragmatic or cultural equivalence. The problem becomes even more complex in NMT because neural systems generally learn translation patterns from bilingual data rather than from an explicit representation of cultural knowledge. As a result, a translation may be grammatically fluent while failing to reproduce the communicative intention of the source text. Post-editing is therefore increasingly recognized as an important stage in professional machine-assisted translation [4, pp. 1–12]. The purpose of this article is to investigate linguo-cultural and cognitive-pragmatic transformations in Uzbek–English NMT and post-editing, focusing on the relationship between automated translation quality and human intervention.

Literature Review. Research on machine translation has evolved from rule-based systems to statistical and neural approaches. Earlier statistical machine translation systems relied heavily on probabilistic correspondences between bilingual language units. NMT introduced an alternative paradigm in which neural networks learn continuous representations of words and sentences and generate translations based on contextual representations [1, pp. 1–10]. The introduction of the Transformer architecture represented an important development in this field. Vaswani et al. demonstrated that attention mechanisms could be used to model sequence relationships without relying exclusively on recurrent neural networks [2, pp. 5998–6007]. This architecture subsequently became fundamental to many contemporary NMT systems. Nevertheless, improved fluency does not necessarily mean improved intercultural communication. House argues that translation quality must consider not only semantic correspondence but also the pragmatic function of discourse and the communicative situation [5, pp. 29–35]. Similarly, Hatim and Mason emphasize that translation is closely connected with discourse, ideology, context, and communicative purpose [6, pp. 1–15]. The cultural dimension of translation has also received considerable scholarly attention. Newmark distinguishes between linguistic and cultural translation problems and identifies culture-specific concepts as particularly difficult for translators [7, pp. 94–102]. Venuti, meanwhile, discusses the tension between domestication and foreignization, emphasizing that translation inevitably involves choices concerning cultural representation [8, pp. 19–20]. From a cognitive perspective, translation involves conceptual processing rather than simple substitution of words. Translation scholars have increasingly examined how translators construct mental representations of source texts and negotiate meaning during translation [9, pp. 7–12]. This perspective is especially relevant to NMT because neural systems encode contextual patterns statistically, whereas human translators can employ world knowledge, cultural experience, inference, and pragmatic reasoning. Post-editing provides a bridge between automated translation and human interpretation. According to ISO 18587, post-editing refers to the process of editing machine-translated output to achieve the required level of quality [10]. The process can involve correction of terminology, grammar, semantics, style, cohesion, and culturally inappropriate expressions.

Results and Discussion. The results of the comparative analysis demonstrate that Uzbek–English Neural Machine Translation (NMT) performs relatively effectively in transferring explicit lexical and propositional information, while significant difficulties remain in the transmission of linguo-cultural and cognitive-pragmatic meanings. The identified transformations were particularly evident in culturally marked expressions, idioms, politeness strategies, address forms, metaphors, modality, and context-dependent utterances. The analysis indicates that lexical-semantic

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transformations constitute one of the most frequent categories of NMT-related problems. In cases where an Uzbek lexical item has several context-dependent meanings, the NMT system may select a formally acceptable but pragmatically inappropriate English equivalent. This problem is especially visible with words and expressions associated with culturally specific concepts. As Wierzbicka notes, lexical meanings are frequently connected with culturally shaped conceptual systems [11, pp. 1–15]. Consequently, accurate translation requires not only lexical correspondence but also consideration of the conceptual background of the source language. A second significant finding concerns culture-specific expressions and idioms. Literal translation frequently preserves the formal structure of an Uzbek expression but fails to reproduce its communicative function in English. For example, an Uzbek expression describing a generous person may be translated literally in a way that is grammatically understandable but unnatural for an English-speaking reader. Post-editing enables the translator to replace the literal construction with a functional equivalent. This finding supports Newmark's observation that cultural expressions require translation strategies extending beyond direct lexical substitution [7, pp. 94–103].

The analysis also revealed substantial differences in the representation of politeness and interpersonal relationships. Uzbek communication frequently employs lexical and grammatical forms that signal respect, age hierarchy, social distance, or interpersonal solidarity. Some of these distinctions do not have direct formal equivalents in English. Consequently, NMT may either omit the pragmatic information or express it through an inappropriate linguistic form. From a pragmatic perspective, this represents a transformation of the interpersonal meaning rather than merely a grammatical discrepancy. House emphasizes that translation quality depends partly on the preservation of the communicative and interpersonal functions of the source text [5, pp. 29–45]. Another important result concerns indirect speech acts. Uzbek speakers may formulate requests, suggestions, or recommendations indirectly in order to maintain politeness and avoid excessive directness. When such constructions are translated mechanically, the resulting English sentence may sound either excessively direct or semantically ambiguous. Human post-editing can restore the intended speech act by selecting appropriate modal verbs, interrogative constructions, or politeness markers. This observation corresponds to the broader principle that translation should preserve communicative function rather than merely grammatical form [6, pp. 1–15].

Table 1. Major Linguo-Cultural and Cognitive-Pragmatic Transformations in Uzbek–English NMT

Transformation category	Main NMT difficulty	Effect on translation	Role of post-editing
Lexical-semantic	Polysemy and contextual ambiguity	Inaccurate lexical choice	Selection of contextually appropriate equivalents
Cultural	Culture-specific concepts	Loss of cultural meaning	Cultural adaptation or clarification
Idiomatic	Literal rendering of idioms	Pragmatic unnaturalness	Functional substitution
Pragmatic	Indirect requests and speech acts	Change in communicative intention	Restoration of speech-act meaning
Politeness	Differences in respect	Loss of interpersonal	Adjustment of politeness

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	and social distance	nuances	markers
Metaphorical	Culture-specific metaphors	Reduction of figurative meaning	Contextual reinterpretation
Terminological	Inconsistent terminology	Reduced conceptual precision	Terminological standardization

The results further indicate that post-editing significantly changes the functional quality of NMT output. While the initial machine-generated translation often provides an acceptable semantic foundation, human intervention is required to improve contextual appropriateness, stylistic naturalness, and cultural adequacy. This confirms that post-editing should not be regarded merely as grammatical correction. It is a complex interpretive process involving semantic evaluation, contextual inference, cultural awareness, and pragmatic decision-making. O'Brien similarly emphasizes the importance of human cognitive activity in post-editing machine-generated translations [14, pp. 197–215]. From a cognitive-pragmatic perspective, the findings suggest that the main limitation of NMT is associated with the interpretation of implicit information. Human translators can use contextual knowledge to infer meanings that are not explicitly expressed in the source text. Neural systems, despite their ability to model contextual patterns, may produce less appropriate results when interpretation depends on cultural experience or non-explicit pragmatic information. Relevance theory emphasizes that successful communication requires the recovery of intended meaning through contextual inference [12, pp. 118–125].

The findings also have implications for the evaluation of NMT systems. Conventional automatic metrics such as BLEU primarily measure lexical or n-gram overlap and therefore cannot fully reflect cultural and pragmatic adequacy [15, pp. 311–318]. A translation may achieve a relatively high automatic evaluation score while still failing to communicate an Uzbek cultural reference or interpersonal intention accurately. Therefore, NMT evaluation for Uzbek–English translation should incorporate semantic accuracy, linguistic fluency, cultural adequacy, pragmatic appropriateness, and post-editing effort. Overall, the results demonstrate that Uzbek–English NMT should be understood as a process involving multiple layers of transformation. The linguistic layer concerns grammar and vocabulary; the cultural layer concerns culturally embedded concepts; the cognitive layer concerns interpretation and conceptualization; and the pragmatic layer concerns communicative intention and interpersonal meaning. Effective post-editing integrates all four dimensions and consequently contributes to a more contextually appropriate and culturally sensitive translation. Thus, the study confirms that human–machine collaboration is particularly important for Uzbek–English translation. NMT can provide speed, consistency, and a useful initial translation, whereas human post-editors contribute cultural knowledge, contextual interpretation, pragmatic awareness, and stylistic judgment. This complementary relationship represents a practical model for improving the quality of AI-assisted translation between Uzbek and English.

Conclusion. Neural Machine Translation has substantially improved the efficiency and fluency of Uzbek–English translation. Nevertheless, linguistic fluency should not be equated with complete translation equivalence. Differences in cultural conceptualization, pragmatic conventions, social relations, idiomatic usage, and discourse organization continue to create challenges for NMT systems. The study demonstrates that linguo-cultural and cognitive-pragmatic transformations represent central dimensions of Uzbek–English machine translation. Culture-specific vocabulary, idioms, metaphors, address forms, indirect speech acts, and modality require interpretation beyond formal linguistic

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correspondence. Post-editing therefore represents more than mechanical correction. It constitutes a cognitive-pragmatic process through which human translators evaluate machine-generated output and restore semantic, cultural, and communicative equivalence. For future NMT development, greater attention should be given to culturally diverse training data, pragmatic annotation, context-sensitive models, and human-in-the-loop translation systems. A combination of neural technologies and expert post-editing can contribute to more accurate and culturally sensitive Uzbek–English translation.

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