

Distributional-Semantic Vectorization of Morphosyntactic Ambiguity: A Transformer-Augmented Parsing Framework for Low-Resource Contemporary Languages

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Abstract. Morphosyntactic ambiguity in low-resource contemporary languages presents a persistent bottleneck for computational linguistic pipelines, undermining both corpus annotation accuracy and downstream semantic interpretation tasks. This study proposes a transformer-augmented parsing framework that integrates distributional-semantic vectorization with probabilistic constraint grammar (PCG) modules to resolve attachment ambiguities in agglutinative and fusional low-resource languages. Drawing on annotated corpora from three typologically distinct language families, we fine-tuned multilingual BERT-variant architectures using a novel contrastive disambiguation objective. Evaluation across standardized syntactic benchmarks demonstrates a statistically significant improvement of 7.3–11.8% in labeled attachment scores over conventional dependency parsing baselines. The findings advance both theoretical models of morphosyntactic interface phenomena and applied frameworks for language documentation and computational lexicography in under-resourced linguistic communities.

Keywords: morphosyntactic ambiguity resolution, low-resource language processing, transformer-based dependency parsing, distributional semantics, probabilistic constraint grammar, multilingual BERT fine-tuning, agglutinative language morphology, contrastive disambiguation objective, computational lexicography

Introduction

The intersection of computational linguistics and contemporary language documentation has emerged as one of the most critically urgent research frontiers of the mid-2020s. As of 2024–2026, an estimated 40% of the world's approximately 7,000 living languages are classified as low-resource or endangered, meaning that their speakers lack access to robust

natural language processing (NLP) infrastructure capable of supporting digital literacy, machine translation, or automated corpus analysis. Within this landscape, morphosyntactic ambiguity—the co-occurrence of multiple syntactically or morphologically valid parses for a given surface string—constitutes a foundational challenge that cascades through every stage of automated linguistic analysis, from part-of-speech tagging and syntactic dependency resolution to semantic role labeling and discourse coherence modeling. The inability to reliably resolve such ambiguities in languages characterized by rich morphological paradigms, including agglutinative structures (e.g., Kazakh, Swahili, Georgian) and complex fusional declension systems (e.g., Latvian, Albanian, Tigrinya), critically impedes both theoretical linguistic inquiry and the development of language technologies serving marginalized speech communities. Previous methodological responses to this problem have largely operated within two divergent paradigms: rule-based constraint grammar systems, which offer interpretive precision but demand extensive manual expert annotation, and purely statistical or neural end-to-end models, which require large-scale labeled training data largely unavailable for low-resource varieties. Neither paradigm adequately addresses the dual requirements of linguistic explainability and computational scalability that characterize applied contemporary language research. The emergence of pre-trained multilingual large language models, particularly transformer architectures fine-tuned on multilingual corpora, has partially mitigated the data scarcity problem; however, existing fine-tuning strategies have not systematically leveraged the rich distributional-semantic geometry of contextual embeddings to directly supervise morphosyntactic disambiguation decisions. This paper addresses these gaps by introducing a transformer-augmented parsing framework that unifies distributional-semantic vectorization with probabilistic constraint grammar modules through a contrastive disambiguation objective specifically designed for morphologically complex, low-resource languages. The proposed framework operationalizes the theoretical notion of the morphosyntactic interface as a structured geometric relation in high-dimensional embedding space, enabling the model to adjudicate between competing parses with reference to both contextual distributional evidence and formally specified grammatical constraints. The remainder of this article is organized as follows. Section 2 provides a critical review of prior work on morphosyntactic disambiguation, constraint grammar architectures, and multilingual transformer adaptation. Section 3 details the proposed framework architecture, including the contrastive objective formulation and PCG integration protocol. Section 4 describes the experimental corpora, language selection criteria, and evaluation metrics. Section 5 reports quantitative results and ablation analyses. Section 6 discusses theoretical implications for the morphosyntactic interface and directions for future extension to additional language families. Section 7 presents concluding remarks.

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