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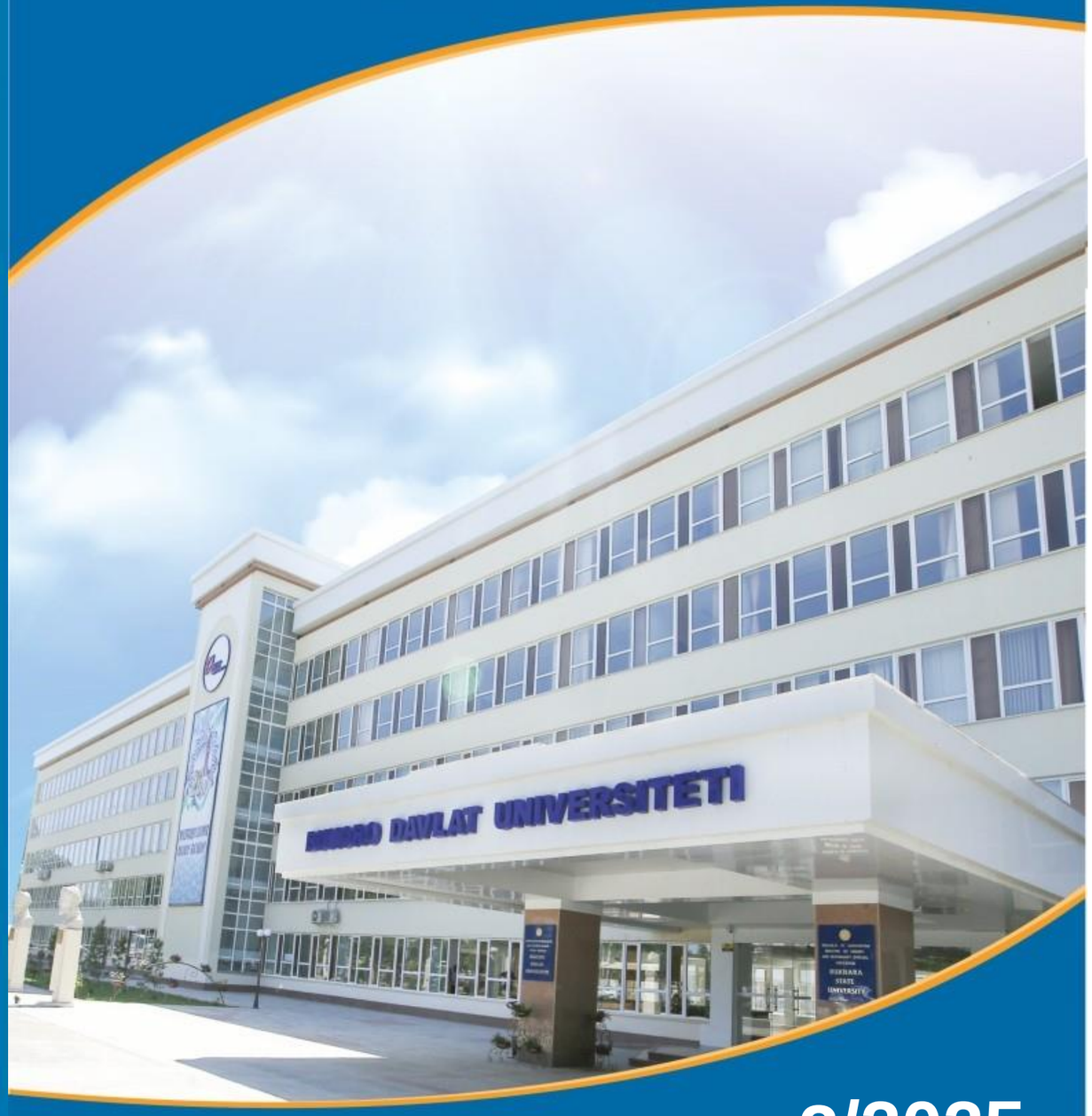

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UDC 81

COGNITIVE FEATURES OF SPEECH COMPRESSION IN MEADA DISCOURSE

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Abstract. *The modern media landscape is characterized by a pervasive trend towards speech compression – the shortening and simplification of messages to accommodate the fast-paced nature of online communication [1]. This phenomenon, driven by technological advancements and evolving social norms, has profound implications for how information is processed and understood. This analysis explores the cognitive features associated with speech compression in media discourse, drawing upon research across various disciplines including psycholinguistics, cognitive hearing science, and computational linguistics. The analysis will consider how compression impacts message comprehension, listener effort, and the overall effectiveness of communication. Furthermore, it will examine the role of individual listener variables, such as age and hearing ability, in mediating the effects of speech compression [2].*

Keywords: *media discourse, speech compression, cognition, allocation, pattern, communicative context, visual information, social implication.*

MEDIADISKURSDA NUQT KOMPRESSIYASIYANING KOGNITIV XUSUSIYATLARI

Annotatsiya. *Zamonaviy media landshafti nutqni siqishning keng tarqalgan tendensiyasi bilan tavsiflanadi - onlayn muloqotning tez sur'atlariga moslashish uchun xabarlarni qisqartirish va soddalashtirish [1]. Texnologik taraqqiyot va rivojlanayotgan ijtimoiy me'yorlar ta'sirida yuzaga kelgan bu hodisa axborotni qayta ishlash va tushunishga chuqur ta'sir ko'rsatadi. Ushbu tahlil turli fanlar, shu jumladan psixolingvistika, eshitish kognitiv fanlari va hisoblash tilshunosligi bo'yicha tadqiqotlarga asoslanib, media nutqida nutqni siqish bilan bog'liq kognitiv xususiyatlarni o'rganadi. Tahlil siqilish xabarni tushunishga, tinglovchilarning harakatiga va umumiy muloqot samaradorligiga qanday ta'sir qilishini ko'rib chiqadi. Bundan tashqari, u nutqni siqish ta'sirida vositachilik qilishda tinglovchilarning yoshi va eshitish qobiliyati kabi individual o'zgaruvchilar rolini o'rganadi [2].*

Kalit so'zlar: *media nutqi, nutqni siqish, bilish, taqsimlash, naqsh, kommunikativ kontekst, vizual ma'lumot, ijtimoiy ta'sir.*

КОГНИТИВНЫЕ ОСОБЕННОСТИ КОМПРЕССИИ РЕЧИ В МЕДИАДИСКУРСЕ

Аннотация. *Современный медиа-ландшафт характеризуется всепроникающей тенденцией к компрессии речи — сокращению и упрощению сообщений для соответствия быстрому темпу онлайн-общения [1]. Это явление, обусловленное технологическими достижениями и развивающимися социальными нормами, имеет глубокие последствия для того, как обрабатывается и понимается информация. Этот анализ исследует когнитивные особенности, связанные с компрессией речи в медиа-дискурсе, опираясь на исследования в различных дисциплинах, включая психолингвистику, когнитивную науку о слухе и компьютерную лингвистику. Анализ будет рассматривать, как компрессия влияет на понимание сообщения, усилия слушателя и общую эффективность коммуникации. Кроме того, он будет изучать роль индивидуальных переменных слушателя, таких как возраст и слуховая способность, в опосредовании эффектов компрессии речи [2].*

Ключевые слова: *медиа-дискурс, компрессия речи, познание, распределение, шаблон, коммуникативный контекст, визуальная информация, социальное значение.*

Introduction. Speech compression, by its very nature, reduces the amount of linguistic information available to the listener [1]. This reduction can manifest in various forms, including shorter sentences, simplified vocabulary, and the omission of contextual details. The cognitive consequences of this information reduction are multifaceted. For instance, listeners may experience increased processing demands as they attempt to fill in the gaps left by the compressed speech [2]. This increased processing load can translate into

greater listening effort and reduced comprehension accuracy, especially in noisy environments or for listeners with pre-existing cognitive or auditory impairments [3]. Furthermore, the reliance on implicit inferences and contextual cues in compressed speech can lead to ambiguity and misinterpretations, particularly when the listener lacks the necessary background knowledge or when the communicative context is unclear [1].

Comprehension of compressed speech necessitates the allocation of cognitive resources – such as working memory and attention – to resolve ambiguities and integrate fragmented information [4]. Listeners must actively engage in predictive processing, anticipating upcoming words and phrases based on limited cues [2]. This active engagement contrasts with the more passive processing that may occur during the comprehension of fully elaborated speech. Age-related cognitive decline can significantly impact this process [2]. Older adults, for instance, may exhibit reduced working memory capacity and slower processing speeds, making them more susceptible to the negative effects of speech compression [4]. Their reliance on different listening strategies may also influence their ability to cope with compressed speech [2]. The cognitive demands imposed by speech compression may also disproportionately affect individuals with cognitive impairments, such as those at risk for dyslexia [3].

The use of multimodal communication, involving multiple sensory channels such as visual and auditory cues, can potentially mitigate the negative effects of speech compression [1]. For instance, visual information, such as facial expressions or gestures, can provide additional contextual cues that help listeners to disambiguate compressed speech [4]. However, the effectiveness of multimodal communication in the context of speech compression is dependent on various factors, including the nature of the visual cues, the level of compression, and the individual differences in listeners' cognitive abilities [1]. Furthermore, the reliance on visual cues introduces an additional cognitive demand, requiring listeners to integrate information from different sensory modalities [4]. This increased cognitive load may negate the potential benefits of multimodal support in certain cases.

The way individuals approach listening to compressed speech can significantly influence their comprehension. Listeners may employ various strategies to compensate for the reduced information, such as focusing on key words, relying on context, or actively filling in missing information [2]. These strategies, however, are not equally effective. Some strategies may lead to more accurate comprehension than others, while others may result in misinterpretations or biases [4]. The choice of listening strategy is likely influenced by a range of factors, including the listener's individual cognitive abilities, their prior experience with compressed speech, and the specific communicative context [2]. Listeners with stronger cognitive skills may be better able to employ effective strategies and maintain comprehension accuracy in the face of compression [4]. Furthermore, familiarity with the topic of the compressed speech may enhance comprehension by providing a richer contextual framework for interpretation [1].

The proliferation of digital media has greatly accelerated the trend towards speech compression [1]. Online platforms, such as social media and messaging apps, often incentivize brevity and efficiency in communication. Moreover, technological limitations, such as character limits in text messages or short video formats, also contribute to the prevalence of compressed speech. The development of artificial intelligence (AI) technologies, such as speech recognition and natural language processing (NLP), has further facilitated the production and consumption of compressed speech [5]. AI-powered tools can automatically compress speech by identifying and removing redundant information, generating concise summaries, or adapting language to specific audiences [6]. However, these technologies also introduce potential biases and inaccuracies that can negatively impact the comprehension of compressed speech [7].

Deep learning models have emerged as powerful tools for analyzing and processing speech data, including compressed speech [8]. These models can be trained to identify patterns and features in speech that are indicative of compression, allowing for the development of automated systems for both compressing and decompressing speech [9]. Deep learning approaches offer the potential to improve the accuracy and efficiency of speech compression, while also mitigating the negative consequences of information loss. Moreover, these models can be used to analyze the cognitive processes involved in comprehending compressed speech, providing valuable insights into the relationship between linguistic features and cognitive demands [10]. However, the development and application of deep learning models for speech processing pose significant challenges, including the need for large annotated datasets, the potential for biases in training data, and the complexity of interpreting model outputs [8].

The widespread adoption of speech compression in media discourse has significant social and cultural implications. The emphasis on brevity and efficiency can lead to a simplification of language and a reduction in the complexity of ideas expressed [1]. This simplification may affect not only the comprehension of information but also the way individuals engage in critical thinking and deliberation. The prevalence of compressed speech may also contribute to the spread of misinformation and disinformation, as concise but

misleading messages can be easily disseminated and widely shared [11]. Furthermore, the trend towards speech compression may exacerbate existing inequalities in access to information and communication, as individuals with limited cognitive resources or language skills may struggle to understand compressed messages [1].

The use of compressed language can facilitate the spread of fake news and disinformation [11]. Short, impactful statements, lacking in nuance and detail, are more easily remembered and shared, regardless of their accuracy. This makes compressed language a particularly effective tool for manipulating public opinion and spreading false narratives [12]. The cognitive biases that influence information processing, such as confirmation bias and the availability heuristic, are further amplified by the use of compressed language. Listeners are more likely to accept information that aligns with their pre-existing beliefs, and the ease with which concise messages are processed increases the likelihood that they will be deemed credible [12]. The detection of fake news often relies on careful analysis of linguistic features and contextual cues, which are precisely the elements that are often reduced or omitted in compressed speech [13].

Speech compression in media discourse is a complex phenomenon with multifaceted cognitive, social, and technological implications. While it can enhance communication efficiency in certain contexts, it can also lead to reduced comprehension, increased listening effort, and the potential for misinformation. Future research should focus on further investigating the cognitive mechanisms underlying the comprehension of compressed speech, exploring the effectiveness of different listening strategies, and examining the impact of speech compression on various demographic groups. The development of AI-powered tools that can effectively compress and decompress speech while preserving meaning and accuracy is also a critical area for future research [6]. Furthermore, a deeper understanding of the social and cultural implications of speech compression, particularly its role in the spread of misinformation and the exacerbation of existing inequalities, is crucial for informing effective interventions and policies [12].

Recent studies have found outstanding results using clauses or discourse structures, instead of isolated words. An algorithm, proposed in, divides sentences into clauses prior to any elimination. Although the results of this last work are good in general, in some cases the main subject of the sentence is removed. The authors attempted to solve this issue by including features in a machine learning approach. Discourse chunking is an alternative to discourse parsing, thereby, showing a direct application to sentence compression as shown in. The authors of these last two works argued that, while discourse parsing at document level is a significant challenge, discourse chunking at sentence level could present an alternative in human languages with limited language processing tools. In addition, some sentence-level discourse models have shown accuracies comparable to human performance. In this work, we use a sentence-level discourse segmentation approach. Formally, “Discourse segmentation is the process of decomposing discourse into Elementary Discourse Units (EDUs), which may be simple sentences or clauses in a 396 A. Molina et al. complex sentence, and from which discourse trees are constructed”. The first step of discourse parsing is discourse segmentation (the next steps are detection of rhetorical relations and building of the discourse tree). However, we can consider segmentation at the sentence level in order to identify segments to be eliminated in the sentence compression task.

The decomposition of a sentence into EDUs using only local information is called *intra-sentence discourse segmentation*. Today, automatic discourse segmentation systems exist for several languages such as English, Brazilian Portuguese, Spanish and French. The cognitive operations of compression during summary writing were formulated as "macrorules" by Brown and Day (1983). Brown and Day proposed four common operations in summary writing as macrorules, which experienced high school and college students self-reported to intentionally and frequently use when writing summaries: deletion, selection, substitution, invention, and combination. Empirical research has shown that linguistic features can reflect the usage of some of the macrorules (Sherrard, 1989). Denhiere (2005) proposed a computational model using sentence representations and latent semantic analysis to model the use of macrorules by participants in an experimental study. Recently, studies in journalism and education have investigated linguistic features of summaries for specific domains by viewing news headlines (Piotrkowicz et al., 2017; Xu and Guo, 2018), research article abstracts (Amnuai et al., 2020), and paper reviews (Leijen and Leontjeva, 2012) as summaries. These works have identified patterns for each domain and shown that the patterns can help writers improve the quality and effectiveness of their summary writing. For example, Leijen and Leontjeva (2012) examined the correlations between the linguistic features of peer reviews of academic papers and the acceptability of the revision suggestions provided in the reviews using a random forest model, and found that the paper authors are more likely to accept and implement the reviewer comments if the comments have more directives. The only cross-domain study of the linguistic influences on the general task of summary writing is Arroyo-Fernández et al. (2019), which compared the differences in the use of several language features, including part-of-speech tags, sentence sentiment, named entity tags, and relation tags from rhetoric structure theory, between humanwritten and machine-generated summaries. ArroyoFernández et al. found that machine-generated summaries show

significantly different behaviors in the usage of named entities from humans. However, these existing works did not discuss the finegrained distributional differences between source document and summary pairs or evaluate how the identified linguistic patterns are related to the perceived summary quality by summary readers. In contrast, we propose a more fine-grained analysis framework of the linguistic patterns present in summarization, analyzing the pairwise relations between source documents and the associated summaries at different granularities in addition to linguistic features of the summaries in isolation. We focused on extreme summarization of expository texts, the task of creating a single-sentence abstractive summary of a single document (Narayan et al., 2018). Extreme summarization is a challenging yet commonly studied task by the automatic text summarization community. Given its tight length constraint, extreme summarization requires more abstractive and compressed summaries compared with other forms of summarization, helping ensure that non-trivial efforts of compression will occur in summarization. In addition, extreme summary datasets tend to have fewer supplemental materials that are non-essential in the source docu7923 ment (Bommasani and Cardie, 2020), providing a purer window on the source compression. In order to compress all the important information from the source document into a single-sentence summary, the extreme summary might show a different morphological, syntactic, and/or semantic pattern from the individual source sentences. We measured such compression in extreme summarization by the change in the sentence-level values of each linguistic feature from source to summary.

The significance of change indicates which features are consistently manipulated by writers during summarization. We modeled the change of each linguistic feature as a single classification feature in a binary logistic regression model trained to classify sentences as either coming from a source document or from a summary. We also investigated the direction and magnitude of change by comparing the average paired difference of each feature between the source sentences and their associated summary. This study offers a comprehensive computational corpus analysis to comprehend how people often compose one-sentence summaries. We employed dynamic time warping with barycenter averaging to examine the fine-grained positional patterns of linguistic features and conducted an analysis of changes in morphological, syntactic, and semantic variables. When determining whether a sentence is a summary or from a source document, our investigations revealed that syntactic and morphological alterations are useful. In comparison to the source sentences, single-sentence summaries typically have greater lexical diversity, morphological expansion, and word specificity.

While the temporal arrangements of lengthy dependencies in summary sentences resemble those of random sentences, summaries are written to mimic the positional arrangements of their source phrases at the word level. The effect of linguistic feature compression on human readers was also assessed. By applying representational similarity analysis to the relationships between quality ratings and language variables, we demonstrated shows there is a strong correlation between quality ratings and morphological traits and lexical variety (type-token ratio). Changes in syntactic properties, including the average dependency length, are associated with readers' opinions of the summaries' freshness, consistency, factual coverage, and abstraction level. The findings indicate that while both summary writers and readers place emphasis on key grammatical elements, there is a discrepancy between writer usage and reader preference in terms of 7929 type-token ratio and word specificity. This suggests that in order to effectively convey the essential information to readers, summary authors must carefully apply semantic compression and expansion. It should be mentioned that because we limited our survey to summaries derived by human participants, we were only able to examine the impact of linguistic feature compression on readers indirectly. We intend to use direct testing in the future by having readers score summary stimuli that have been specially altered using particular compression patterns.

Conclusion. The study of speech compression requires an interdisciplinary approach, integrating insights from psycholinguistics, cognitive science, communication studies, and computer science to fully grasp its impact on individuals and society [14]. Cross-cultural studies are also needed to understand how varying linguistic and cultural norms influence the production and interpretation of compressed speech [15]. Finally, research should explore the ethical considerations associated with the use of AI-powered tools for speech compression, ensuring that these technologies are developed and deployed responsibly [7].

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