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MULTIMODAL TRANSLATION IN SCIENTIFIC COMMUNICATION: CHALLENGES OF COMBINING TEXT, AUDIO AND VIDEO

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Annotation:
This article explores the intricacies of multimodal translation in scientific communication, focusing on the simultaneous translation of textual, auditory, and visual elements. With the rise of digital scientific discourse, translators now face the complex task of rendering content across various modalities. Drawing from examples such as subtitled YouTube science lectures, podcast transcriptions, and academic video explainers, the article identifies key challenges including synchronicity, terminological coherence, cultural transference, and cognitive load. The study highlights the urgent need for integrated translation strategies that acknowledge multimodal semiotics and ensure conceptual accuracy in multilingual dissemination.

Keywords: multimodal translation, scientific communication, subtitling, synchronization, semiotic integration, cognitive load, audiovisual equivalence.

Annotatsiya:
Ushbu maqolada ilmiy kommunikatsiyadagi multimodal tarjimaning murakkab jihatlari tahlil qilinadi. Ayniqsa, matn, audio va video unsurlarining bir vaqtning o‘zida tarjima qilinishi zaruratidan kelib chiqadigan muammolar yoritiladi. YouTube'dagi ilmiy darslar subtitrlar bilan, podkast transkripsiyalari, video eksplanatorlar kabi misollar asosida tarjimonlar duch keladigan asosiy muammolar: sinxronlashtirish, terminologik izchillik, madaniy konversiya va kognitiv yuklanish tahlil qilinadi. Maqolada multimodal semiosferani hisobga olgan, integratsiyalashgan tarjima strategiyalari zarurligi ilmiy asosda ko‘rsatib beriladi.

Kalit so‘zlar: multimodal tarjima, ilmiy kommunikatsiya, subtitr, sinxronlik, semantik integratsiya, kognitiv yuklama, audiovizual ekvivalentlik

Аннотация:
Статья рассматривает особенности мультимодального перевода в научной коммуникации, в частности, проблемы одновременного перевода текста, аудио и видео. На примерах научных видеолекций с субтитрами, транскрипций подкастов и образовательных видеоматериалов выявлены основные трудности: синхронность, терминологическая согласованность, культурная трансформация и когнитивная нагрузка. Подчёркивается необходимость комплексных стратегий перевода, учитывающих мультимодальные особенности и обеспечивающих точность в многоязычном научном дискурсе.

Ключевые слова: мультимодальный перевод, научная коммуникация, субтитры, синхронизация, семиотическая интеграция, когнитивная нагрузка, аудиовизуальный эквивалент

The landscape of scientific communication is undergoing a radical transformation, catalyzed by the shift toward digital and audiovisual dissemination. Scientific content is increasingly presented in **multimodal formats**, combining text, audio, video, and graphical data. This development poses new challenges for translators, who must now grapple with **cross-modal semantic consistency**, **synchronization**, and **cognitive coherence**.

As Gambier (2006) asserts, “Multimodal translation requires not only linguistic competence but also semiotic awareness and intermodal calibration” [1, p. 156]. Nowhere is this more evident than in subtitled video lectures, podcast translations, and online academic presentations where meaning is co-constructed across modalities.

Theoretical Framework

Multimodal translation lies at the intersection of **audiovisual translation**, **scientific translation**, and **semiotic theory**. It integrates diverse modalities that each carry **distinct semiotic values** (Kress & van Leeuwen, 2001) [2, p. 47].

In scientific contexts, this interplay becomes more pronounced due to the specialized nature of terminology, conceptual density, and the need for precise knowledge transfer.

Subtitling, a key form of multimodal translation, is especially constrained by time-space limitations and reading speed parameters. When scientific jargon and complex formulations are involved, these constraints amplify significantly.

- **Multimodality**: The orchestration of multiple communicative modes (verbal, visual, gestural, spatial, auditory).
- **Semiotic density**: The concentration of meaning across different channels.
- **Cognitive load theory** (Sweller, 1998): Suggests that complex, multimodal input can overload the working memory, especially in a second language.

Core Challenges in Multimodal Scientific Translation

Synchronicity and Timing

Scientific videos often require **precise synchronization** between subtitles and speech. Even minor misalignments can distort the intended message or obscure critical terms. Example: In a YouTube lecture on CRISPR-Cas9, the subtitle for "gene editing precision" appears two seconds before the actual visual demonstration, leading to confusion in concept association.

Terminological Consistency Across Modes

Scientific terms may appear in **speech**, **on-screen text**, and **graphs**, often with variant forms or abbreviations. Maintaining coherence is essential.

For instance, "greenhouse gases" might be said verbally, shown as "GHG" in graphics, and labeled "carbon emissions" in text. A translator must reconcile these with correct and consistent Uzbek equivalents (e.g., issiqxona gazlari, karbon chiqindilari) depending on context [3, p. 89].

Cultural Adaptation of Visual/Verbal Signs

Some visual metaphors may be culturally specific. Example: A climate change animation shows a polar bear on melting ice. In cultures unfamiliar with polar wildlife, the symbolism may be lost or require supplementary textual explanation.

Cognitive Load and Information Fragmentation

Combining fast-paced speech, scrolling text, and moving visuals risks **overwhelming the viewer**, especially when reading subtitles in a non-native language.

As Mayer emphasizes, "Cognitive load must be managed to facilitate learning, especially when modalities are competing rather than complementary" [4, p. 121].

Practical Implications for Translators

Challenge	Translator's Response
Subtitle–audio misalignment	Use software with frame-by-frame timing tools
Multiterm variation	Construct a terminology table per video segment
Culture-specific imagery	Add concise in-subtitle clarifications or footnotes
Visual-textual dissonance	Align terminological choices with graphical labels
Cognitive overload	Prioritize semantic essentials; consider resegmentation

Toward Integrated Translation Strategies

Translators must develop **interdisciplinary competencies**, including:

- Familiarity with **audiovisual editing software** (e.g., Aegisub, Subtitle Edit)
- Knowledge of **scientific terminology databases** and corpus tools
- Skills in **transediting** (restructuring content for clarity)
- Awareness of **visual grammar** and symbolic resonance

As Díaz-Cintas & Remael (2007) point out, "The translator of today is increasingly an audiovisual mediator, not just a linguistic conduit" [5, p. 33].

Multimodal translation in scientific communication is more than translating words — it is the translation of **semiotic systems**. The success of such translations depends on the translator's ability to manage modality interaction, ensure terminological and conceptual fidelity, and reduce cognitive friction for the target audience.

Future research must focus on developing **standardized guidelines** for multimodal scientific translation, integrating linguistics, cognitive science, and digital

technology. In an age where scientific literacy is mediated through screens, the translator becomes a critical architect of understanding.

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