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Original Paper

Cognitive Load and Translation Accuracy in Technology Assisted Simultaneous Interpreting Enabled by Artificial Intelligence

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Abstract

This paper uses eye-tracking research to examine the cognitive load and translation accuracy of simultaneous interpretering with and without technology-assisted in the direction of Chinese-to-English translation and to explore the moderating role of simultaneous interpreting ability. It was found that the new type of simultaneous interpreting assisted by speech recognition technology and machine translation technology can significantly reduce the cognitive load of student interpreters and improve the accuracy of translation. However, the advantages of technology-assisted simultaneous interpreting are not significant enough for professional interpreters compared with student interpreters. This paper explains the results of the study from the perspectives of memory pressure, bilingual switching pressure, and the "ceiling effect".

Keywords

echnology-assisted simultaneous interpreting, simultaneous interpreting ability, cognitive load, translation accuracy, Artificial Intelligence

1. Introduction

1.1 Research Background

Artificial Intelligence (AI) is at the forefront of human technological advancement in the 21st century and has garnered worldwide attention. Various countries in Europe and America have positioned AI as a pillar or key area of national growth strategies. China's "14th Five-Year Plan" also lists AI as a frontier area in scientific and technological endeavors, elevating it to a national strategic status. Against this backdrop, interdisciplinary research related to artificial intelligence is thriving. Technologies based on deep neural networks, such as machine translation and speech recognition, have reached application levels. In 2017, the Shanghai International Studies University and iFlytek jointly established the Smart Translation and Speech Recognition Research Laboratory, opening new possibilities for research in this field through collaboration between enterprises and universities (Srivastava, 2018; He, 2019).

Artificial intelligence continues to reshape interdisciplinary research across diverse domains, demonstrating significant impacts in areas such as healthcare, education, and public services. In healthcare, AI has been pivotal in advancing precision medicine and wearable health monitoring technologies, allowing for more personalized treatment plans and continuous patient monitoring outside of traditional clinical settings (Kusters et al., 2020). Similarly, in education, AI has facilitated a shift towards more adaptive learning environments where educational content is tailored to the individual learning pace and style of students. This adoption of AI in education has sparked discussions on the need for more robust AI literacy among educators to fully leverage AI's potential in teaching and learning (Baum, 2020).

Furthermore, AI's integration into public sector services has brought about efficiencies in resource management and service delivery, contributing to smarter city initiatives and improved governmental operations. The use of AI in these sectors often requires interdisciplinary approaches that blend technical AI research with insights from social sciences, ethics, and policy-making to ensure equitable and effective outcomes. The challenges posed by such integrations include ensuring transparency, overcoming dataset biases, and addressing ethical considerations, which are crucial for gaining public trust and achieving sustainable implementation of AI technologies (Kusters et al., 2020). These expansions in AI applications highlight the ongoing need for an adaptive regulatory framework that can respond to the rapid developments in AI and its implications across various sectors.

Simultaneous interpretation is regarded as the "Holy Grail" of artificial intelligence (Zhang, 2017). The application of AI in assisting interpreting is still in the exploratory phase, and the concept corresponding to machine-assisted translation has not yet been applied in interpreting (Ehrlich & Napier, 2015). Indeed, machines, relying on big data and increasingly mature speech recognition technology, can provide interpreters with real-time transcription and memory aids. However, it remains questionable whether machine translation at the linguistic level can enhance interpreters' understanding and output at the semantic level. Interpreting tests the interpreter's ability to understand the overall semantics within the context of the discourse, relying more on "listening discrimination and logical analysis memory capacity" and "logical expression ability" (Liu, 2011). This study aims to investigate whether technological assistance in voice recognition and transcription, as well as machine translation, can improve the quality of translation, which requires further verification. This research will employ eye-tracking methodology to examine the cognitive load and translation quality in technology-assisted and non-technology-assisted simultaneous interpreting from Chinese to English, and explore the moderating effect of simultaneous interpreting skills.

1.2 Problem Statement

In simultaneous interpreting, interpreters are required to engage in multiple activities concurrently, including listening, understanding, memorizing, producing, and monitoring, which often leads to a significant cognitive load (Gile, 2009). Currently, speech recognition technology and machine translation have essentially achieved high-quality, low-latency real-time speech-to-text and machine translation capabilities, which can display the speaker's original text and the corresponding machine translation on the screen in real time for the interpreter. Wang and Fu (2020a, p. 16) have noted, "Human-machine collaboration is an inevitable trend in the development of interpreting practices in the era of artificial intelligence." Therefore, the extent to which technology can assist interpreters in optimizing the simultaneous interpreting process and enhancing the quality of translations is a significant issue in the research of interpreting in the age of artificial intelligence.

Recent advancements in speech recognition and machine translation technologies have ushered in a new era of real-time transcription and translation, potentially reducing cognitive load by providing interpreters with instant textual feedback. However, the actual effectiveness of these technological aids in improving translation quality and reducing cognitive load during simultaneous interpreting remains under-explored (Tiselius & Sneed, 2020). Additionally, while eye-tracking technologies have been extensively used to study cognitive processes in translation, their application in examining how technology impacts simultaneous interpreting has not been fully realized (Su & Li, 2021).

The introduction of eye-tracking methods opens new avenues for assessing the cognitive burden and output quality in technologically assisted interpreting scenarios. Eye-tracking metrics such as gaze patterns, fixation durations, and pupil dilations offer quantifiable data that reflect the cognitive effort expended by interpreters (Katona, 2022). These metrics can provide valuable insights into how interpreters manage cognitive resources when using technological tools like real-time transcription and translation aids. Furthermore, understanding the variation in cognitive load and translation quality between novice and experienced interpreters can inform targeted training programs that enhance professional skills in technologically enriched environments (Joseph & Murugesh, 2020).

Given the complexities of simultaneous interpreting and the rapid integration of AI technologies, there is a significant research gap in evaluating how these technologies alter interpreting practices. The eye-tracking approach is particularly promising for measuring cognitive load and assessing the quality of interpretation in real-time, offering a direct observation of the interpreter’s cognitive state during the interpreting process. This research will utilize eye-tracking to compare cognitive load and translation quality under different interpreting scenarios—those aided by technology and those not—to better understand the impacts of technological assistance on interpreter performance. The findings could lead to more effective use of technology in interpreting, ultimately enhancing communication accuracy and interpreter satisfaction.

Overall, the process of simultaneous interpreting can be divided into three stages: pre-interpreting preparation, mid-interpreting action, and post-interpreting management. This study focuses on technologically assisted simultaneous interpreting during the mid-interpreting action stage, where interpreters listen to the speaker while viewing information points on slides, and can refer to real-time original subtitles provided by speech recognition technology and real-time translated subtitles provided by machine translation technology. This study utilizes eye-tracking methods to examine the cognitive load and translation quality of this new form of simultaneous interpreting under technological assistance, and how these are moderated by the interpreters' skills.

Building on the analysis above, this study employs eye-tracking methods to investigate the impact of different simultaneous interpreting modes (i.e., without technological assistance and with technological assistance) on interpreters' cognitive load and translation quality. It also explores whether there are differences between student interpreters and professional interpreters in these impacts.

1.3 Research Questions

This study aims to answer the following four questions:

1) In simultaneous interpreting, what are the differences in cognitive load between interpreters with and without technological assistance?

2) In simultaneous interpreting, what are the differences in translation quality between interpreters with and without technological assistance?

3) Does the impact of the simultaneous interpreting mode on cognitive load vary depending on the interpreter's simultaneous interpreting skills?

4) Does the impact of the simultaneous interpreting mode on translation quality vary depending on the interpreter's simultaneous interpreting skills?

1.4 Research Objectives

Corresponding to the research questions, the research objectives are listed as follows.

1) Research Objective 1 (Quantifying Cognitive Load Differences):

To and compare the cognitive load of interpreters during simultaneous interpreting sessions with and without technological assistance.

- To employ eye-tracking technology to record and analyze key metrics such as pupil dilation, fixation duration, and blink rate. These metrics will serve as indicators of cognitive load.
- To conduct sessions with both setups and statistically analyze the differences in the collected eye-tracking data.

2) Research Objective 2 (Translation Quality Variability):

To evaluate the differences in translation quality between technologically assisted and unassisted simultaneous interpreting.

- To utilize both objective assessment tools (such as error rate analysis and coherence scoring) and subjective evaluations (through expert reviews of translation outputs).
- This dual approach will allow for a comprehensive quality assessment of the translations produced under different conditions.

3) Research Objective 3 (Effect of Interpreting Skills on Cognitive Load):

To investigate how the cognitive load differences between technology-assisted and non-assisted interpreting vary according to the interpreters' skill levels.

- To segment interpreters into groups based on their experience (novice, intermediate, and expert) and use eye-tracking data to compare the cognitive load across these groups and across interpreting scenarios.
- To employ statistical interaction analysis to understand the relationship between skill level and technology use on cognitive load.

4) Research Objective 4 (Role of Interpreting Skills in Translation Quality):

To determine if the effects of simultaneous interpreting mode on translation quality are moderated by the interpreters' skills.

- To perform a detailed analysis of translation quality using the metrics established in Objective 2, grouped by interpreter skill level.
- To analyze the data using multivariate regression models to isolate the effects of interpreting skills and technological assistance on translation quality.

To address research questions 1 and 3, this study proposes to construct a linear mixed-effects model, using simultaneous interpreting mode (with and without technological assistance) and interpreting skills (student interpreters, professional interpreters) along with their interaction as fixed effect factors. Subjects and experimental materials will be considered as random effects, with average gaze duration as the dependent variable.

For research questions 2 and 4, this study plans to invite a professional interpreter and an interpreting teacher to assess the accuracy of the translations. Before assessment, the two evaluators will be briefed on the theme and content of the experimental texts, the standards for accuracy assessment, and the assessment procedures. During scoring, evaluators will listen to the interpreting audio of each subject while reading the transcribed original texts and each subject's translated texts.

1.4.1 Supplementary Objective

In addition to the primary objectives, this research aims to develop guidelines for the integration of technological tools into interpreter training programs. The objective is to formulate actionable recommendations based on the analyses of cognitive load and translation quality from the initial objectives. These recommendations will serve as best practices for incorporating technology into training curricula. Methods will include synthesizing the results of the earlier objectives to establish a comprehensive set of guidelines. These guidelines are intended to optimize the use of technological aids in training settings, aiming to reduce cognitive load and enhance translation quality across various skill levels of interpreters. This supplementary objective is designed to ensure that the benefits of technological advancements are effectively translated into practical training improvements, thus equipping future interpreters with the necessary tools to excel in a technologically evolving professional landscape.

1.5 Research Significance

The integration of Artificial Intelligence (AI) technologies such as speech recognition and machine translation into the field of interpreting represents a critical shift, bridging theoretical frameworks with practical applications. This expansion seeks to assess both the theoretical implications and practical utilities of AI technologies in interpreting, offering a nuanced view of their transformative potential.

1.5.1 Theoretical Significance

Theoretically, this research enriches interpreting studies by exploring how AI technologies can modulate cognitive load and enhance translation quality. Existing cognitive models of interpreting primarily focus on human capacities; this study proposes to extend these models to include interactions with AI technologies. By examining AI's role in reducing cognitive overload and facilitating linguistic processing, the research could lead to significant revisions in how interpreters' cognitive processes are understood. These insights aim to establish a new hybrid theoretical framework that integrates the efficiency of AI with the nuanced understanding of human interpreters, pushing the boundaries of current interpreting theories.

1.5.2 Practical Significance

On a practical level, AI technologies are already employed in various non-professional interpreting scenarios such as travel translation, video subtitle assistance, simple communications, and basic language learning, where the linguistic demands are relatively low and error tolerance is high. This research seeks to evaluate the application of these technologies in more complex, high-stakes environments like conferences and business negotiations, where accuracy and depth of understanding are crucial. By assessing AI's ability to support interpreters in these settings, the study will offer valuable insights into optimizing AI tools for high-level interpreting tasks. Additionally, findings will provide actionable guidelines for integrating these technologies into interpreter training programs, enhancing both the preparation process and the real-time interpreting performance. This practical application is critical for developing best practices that leverage AI to improve translation outcomes, automate preparatory tasks, and provide interpreters with anticipatory knowledge to enhance overall performance in professional settings.

2. Literature Review

2.1 Introduction

This chapter conducts a comprehensive review of the existing literature on the integration of Artificial Intelligence (AI) in the field of simultaneous interpreting. It explores the transformative potential of AI technologies and their application in enhancing interpreting practices, highlighting the advancements in speech recognition and language processing that have led to more efficient and accurate interpretation. The review delves into the impact of these technologies on the cognitive processes of interpreters, examining how they assist in managing the complex demands of simultaneous interpreting. Additionally, the chapter assesses the extent of technological support provided during various stages of the interpreting process and identifies significant research gaps that offer directions for future investigations. This synthesis of scholarly works aims to underscore the ongoing developments and challenges at the intersection of AI and interpreting studies, setting the stage for a deeper understanding of both the benefits and the limitations of technologically assisted interpreting.

2.2 Overview of Artificial Intelligence and Simultaneous Interpretation

Artificial Intelligence (AI) continues to redefine the boundaries of technology and cognitive science, particularly in the field of simultaneous interpretation. Broadly speaking, AI can be defined as a rational behavior system, a discipline that strives to explain and mimic intelligent behavior through computational processes (Schalkoff, 1990). The computational systems of AI can be understood as deep learning networks based on mathematical modeling. Among these, the Recurrent Neural Network (RNN) can retain a memory state to process a sequence of inputs, serving as the cornerstone for the implementation of speech recognition and natural language processing (Gu, 2016).

The advancement in AI has led to significant improvements in speech recognition systems and language processing, making simultaneous interpretation more accurate and efficient. Recent studies suggest that AI's integration into simultaneous interpreting tools not only supports human interpreters but also enhances the overall interpreting quality by reducing delays and improving the precision of translated content (Zhang, 2017; Darwish, 2022).

Furthermore, modern AI applications in interpreting not only handle straightforward translation tasks but also complex linguistic nuances, adapting in real-time to different dialects and contextual clues, thereby enhancing communication effectiveness across diverse linguistic barriers. For example, new research has highlighted the development of AI technologies that assist in interpreting not just in dyadic interactions but in complex, multilingual conferences and seminars, showcasing AI's growing role in high-stakes environments (Geng et al., 2022).

These advancements underscore AI's potential to transform simultaneous interpreting by improving the interpreter’s ability to manage cognitive load, thus enabling better focus on the semantic layers of communication. AI's ability to learn and adapt through neural networks and machine learning models exemplifies this progress, as these technologies continue to evolve and learn from real-world interpreting scenarios, thereby continuously refining their accuracy and effectiveness.

2.3 Technological Assistance in Simultaneous Interpreting

Research on technologically assisted simultaneous interpreting focuses on the interactions and collaborative effects between interpreters and technological tools during the three stages of the interpreting process (such as Wang & Fu, 2020b). It can be said that the most direct assistance technology offers to simultaneous interpreters is during the active interpreting phase, but research in this area is still in its initial stages (such as Defrancq & Fantinuoli, 2021; Prandi, 2023; Sun, Li, & Lu, 2021; Lu, 2022, 2023). Lu (2022; 2023) compared the cognitive processes, capabilities, and translation quality of human interpreters with machines in simultaneous interpreting, finding that machines can compensate for the lack of cognitive energy in human interpreters during the interpreting process. This finding points out that there is significant room for development in research on machine-assisted human translation, providing strong empirical support for studies of technologically assisted simultaneous interpreting.

Existing research primarily focuses on the impact of technology use during the active phase of simultaneous interpreting on translation quality. Sun, Li, and Lu (2021) compared the quality of English-to-Chinese simultaneous interpreting by student interpreters with and without technological assistance. They found that the overall interpreting performance of student interpreters was slightly better with technological assistance than without it. Defrancq and Fantinuoli (2021) also found that student interpreters could significantly improve the accuracy of numeric translations in simultaneous interpreting from English to Dutch with technological help. Cheung and Li (2022) and Yuan and Wang (2023) additionally discovered that technology enhanced the accuracy of English-to-Chinese translations, particularly for numbers and proper nouns.

2.4 Cognitive Load and Technology in Interpreting

It is noteworthy that the aforementioned studies on technologically assisted simultaneous interpreting primarily investigate the process of translating from a foreign language into a native language, without exploring the translation process from a native language into a foreign language. Moreover, only a few studies have examined the cognitive processes involved in interpreters' use of technological tools during simultaneous interpreting practice (Cheung & Li, 2022; Yuan & Wang, 2023). From the perspective of cognitive ergonomics, research on technologically assisted simultaneous interpreting should not only focus on the impact of technology on the interpreting product but also consider its effects on the cognitive and psychological processes of interpreters, such as cognitive load, attention distribution, and cognitive friction (Mellinger, 2019; Fantinuoli, 2023). Existing research often uses subjective scales to examine the cognitive load of interpreters during technologically assisted interpreting (Cheung & Li, 2022; Chen & Kruger, 2023). In recent years, eye-tracking has increasingly been applied to the study of cognitive processes in translation, providing more objective and comprehensive data on cognitive load measurement (Su & Li, 2022). In new forms of technologically assisted simultaneous interpreting, interpreters are exposed to rich visual-verbal information, such as real-time original subtitles and real-time translated subtitles. Therefore, using eye-tracking to examine interpreters' gaze behavior during technologically assisted interpreting can provide further evidence to support current conclusions about cognitive load.

In technologically assisted simultaneous interpreting, the speech content heard by interpreters and the real-time original subtitles provided by speech recognition technology are essentially the same verbal information, presented in auditory and visual forms. This is what cognitive psychology describes as the redundancy effect. Cognitive Load Theory suggests that the redundancy effect requires recipients to expend more cognitive effort to relate and coordinate auditory and visual verbal information, thereby increasing the workload on the recipient’s working memory (Sweller, Ayres, & Kalyuga, 2011). Heikkilä, Alho, and Tiippana (2017) found that the redundancy effect does not enhance recognition memory for auditory or visual verbal information. This finding is explained by Baddeley's (2012) working memory model: auditory and visual verbal information are processed within the phonological loop of working memory and do not complement each other, thus failing to enhance recognition memory. It is noteworthy that these theoretical perspectives are derived from monolingual processing contexts. Whether the same conclusions can be drawn from bilingual processing remains to be explored, and the applicability of the above reasoning requires continual investigation.

In fact, sporadic research findings on technologically assisted simultaneous interpreting (such as Cheung & Li, 2022; Chen & Kruger, 2023) do not align with the aforementioned theoretical perspectives. Cheung and Li (2022) invited student interpreters to perform English-to-Chinese simultaneous interpreting both with and without the assistance of speech recognition technology, and assessed the interpreters' subjective cognitive load using the Paas scale. The study found that students perceived interpreting with speech recognition technology assistance to be easier, as the real-time original subtitles provided by the technology allowed them more time to process the source information.

Existing studies almost exclusively involve student interpreters as subjects, with few exploring the scenario of professional interpreters working under technologically assisted conditions, as well as the relationship between technologically assisted simultaneous interpreting and interpreting skills. Research has found that the simultaneous interpreting abilities of professional interpreters and student interpreters are significantly different (Lu, Li, D. F., & Li, L. Q., 2023), and they exhibit notably different processing behaviors during interpreting (Chmiel & Lijewska, 2019; Stachowiak-Szymczak & Korpal, 2019). Therefore, studying the cognitive load and translation quality of technologically assisted simultaneous interpreting in conjunction with interpreting skills can enrich our understanding of technologically assisted simultaneous interpreting.

2.5 Research Gaps and Conclusion

Despite extensive exploration of artificial intelligence in simultaneous interpreting, several gaps persist that warrant further investigation. Most existing studies focus primarily on the interpreting performance of student interpreters, with limited insights into the professional interpreters' experience under technologically assisted conditions. This oversight highlights a critical need for research that encompasses a broader range of interpreter expertise, particularly examining how professionals manage the cognitive and technical challenges of simultaneous interpreting with AI tools.

Additionally, while current research has effectively illustrated the benefits of technology in reducing cognitive load and enhancing translation accuracy, there is a notable deficiency in studies examining the interpreting process from native languages into foreign languages. The complex dynamics of such translation processes may present unique challenges and opportunities for AI integration, suggesting a significant area for future scholarly inquiry.

Furthermore, the existing literature predominantly discusses the redundancy effect within monolingual contexts. The implications of this effect in bilingual or multilingual settings remain underexplored, particularly how it affects cognitive load and interpreting quality across different language pairs. This gap underscores the need for studies that not only apply but also challenge and expand existing cognitive theories in the context of technologically assisted multilingual interpreting.

Overall, the review of literature demonstrates that artificial intelligence has the potential to profoundly influence the field of simultaneous interpreting. AI's capacity to handle complex computational tasks can significantly aid interpreters by reducing delays, minimizing cognitive load, and improving overall translation accuracy. Innovations in speech recognition and deep learning have enabled more sophisticated interpretation aids, which can adapt in real-time to the nuances of spoken language, thus offering substantial support to interpreters engaged in demanding communicative settings. Despite these advancements, the full integration of AI into simultaneous interpreting practices requires careful consideration of both technological capabilities and human factors. As AI systems continue to evolve, ongoing research should aim to not only leverage these technologies to enhance interpreting performance but also to ensure that they support interpreters in a manner that respects and augments their expertise.

The need for more comprehensive research incorporating professional interpreters, multilingual contexts, and deeper exploration of cognitive effects such as the redundancy effect in bilingual settings is evident. Addressing these gaps will not only enrich the academic understanding of AI's role in simultaneous interpreting but also guide the development of more effective and empathetic technologies that enhance rather than overshadow the human element of this skilled profession.

3. Methodology

3.1 Research Framework

This study will employ eye-tracking research methods to examine the cognitive load and translation quality during English-Chinese bidirectional interpreting processes, focusing on the effects of technological assistance. The investigation will compare scenarios with and without technological tools to understand their impact on interpreting efficiency and effectiveness.

The core of this research will explore how cognitive load and translation quality are influenced by the incorporation of real-time transcription and translation technologies. By examining these variables under different conditions—technologically assisted versus non-assisted interpreting—this study aims to provide insights into the practical benefits and potential limitations of AI tools in professional interpreting settings.

Additionally, the moderating role of interpreters' skills will be examined to assess whether technology's impact varies across different levels of interpreter expertise. This will help identify if technological tools offer uniform benefits or if they are more advantageous for interpreters at certain skill levels.

This streamlined framework sets the stage for a detailed analysis while reserving more specific discussions of methodology and data collection for later sections. The results are anticipated to contribute valuable perspectives on the integration of technology in simultaneous interpreting, guiding future implementations and training programs.

3.2 Experimental Preparation

3.2.1 Sampling Strategies

This study plans to recruit 20 participants, strategically divided into two distinct groups based on their level of interpreting expertise: student interpreters and professional interpreters. The student interpreter group will include 15 undergraduate students majoring in translation studies. These students will have an average age of 21 and will have all completed at least one semester of formal training in simultaneous interpreting, ensuring a foundational level of proficiency necessary for the experimental tasks. This group is selected to provide insights into the learning curve and adaptive strategies of relatively novice interpreters in handling technologically assisted interpreting tools.

The professional interpreter group will consist of 5 seasoned interpreters, each with a minimum of three years of professional interpreting experience. This group is chosen to assess the effectiveness of technology assistance among interpreters who are already well-versed in complex interpreting scenarios, allowing for a comparison of how seasoned professionals leverage new AI tools compared to those still acquiring their skills.

Participants will be native Chinese speakers with a high proficiency in English, ensuring that language proficiency does not confound the results related to interpreting skills and technology use. All participants will have normal or corrected-to-normal vision, a requirement for the accurate tracking of eye movements in the eye-tracking segments of the study.

Recruitment will be conducted through professional interpreting associations, translation studies departments at universities, and via networks that professionals in this field commonly use. This approach ensures a diverse range of interpreters in terms of background and experience, enhancing the generalizability of the study findings.

Participants will be fully briefed on the nature of the study and the use of eye-tracking technology, and informed consent will be obtained prior to the commencement of the experiment. This consent will cover ethical considerations such as the right to withdraw, confidentiality, and the use of data solely for academic purposes. Voluntary participation is emphasized to ensure that all individuals are comfortable and willing to engage fully in the research process, thereby reducing potential biases that might arise from coerced participation.

3.2.2 Experimental Design

The experiment will utilize a 2 (simultaneous interpreting mode: without technological assistance, with technological assistance) × 2 (interpreting ability: student interpreters, professional interpreters) factorial design. In this setup, the interpreting mode is a within-subject factor, and the interpreting ability is a between-subject factor. The key design of the former aims to investigate the differences in the interpreting process and quality with and without technological assistance by altering the technological support conditions. The latter's design purpose is to explore whether the interpreting ability moderates the process and quality of technologically assisted interpreting.

The study will use two sets of experimental materials, each tailored for one of the interpreting modes. Both sets include 4 Chinese audio files and their corresponding Chinese texts. The materials are centered on educational topics and contain 4-6 numbers and 4-8 complex linguistic structures (i.e., head-final structures) with no professional jargon, moderate information density, and clear, well-structured sentences. The two sets are roughly equivalent in terms of vocabulary size, sentence count, paragraph count, lexical richness, text difficulty, and audio duration.

For the non-technologically assisted interpreting mode, key information points will be extracted from the 4 Chinese texts to create 4 Chinese slides. Similarly, for the technologically assisted interpreting mode, key information points will be extracted from the 4 Chinese texts to produce another set of 4 Chinese slides. In the technologically assisted interpreting sessions, original and translated subtitles will appear in real-time below the slides.

3.3 Experimental Procedures

3.3.1 Equipment and Setup

The experiment will be conducted using the Tobii Pro Spectrum eye tracker, known for its high sampling rate, which is crucial for capturing the rapid eye movements typical in reading and interpreting tasks. Experimental materials will be prominently displayed on a high-definition LED screen to ensure clarity and ease of reading for all participants.

3.3.2 Technology and Software

Real-time transcription and translation will be facilitated using Tencent's advanced simultaneous translation software, incorporating cutting-edge speech recognition and machine translation technologies. This setup aims to simulate a realistic environment where interpreters typically work, providing real-time original and translated subtitles that appear below the displayed content on the screen.

3.3.3 Familiarization and Practice Sessions

Prior to the formal experiments, participants will undergo practice sessions to familiarize themselves with the experimental setup and procedures. Participants will complete a round of practice in both non-technologically assisted and technologically assisted simultaneous interpreting to familiarize themselves with the presentation of the experimental materials, specifically the sequential display of 4 slides. Participants will be instructed to ensure the accuracy, completeness, and fluency of their translations as much as possible. These sessions will help minimize any potential learning effects during the actual recording of data and ensure that participants are comfortable with the technology and format of the interpreting tasks.

3.3.4 Eye-Tracking Data Collection

Tobii Pro Lab software will be tasked with recording detailed eye-tracking data, which includes several critical metrics such as fixation duration, saccade paths, blink rate, and pupil dilation. These metrics are essential indicators of cognitive load and will be analyzed to determine how technological assistance impacts the cognitive demands placed on interpreters.

3.3.5 Translation Accuracy Assessment

Based on the content features of the experimental texts, this study will focus on the overall accuracy of translations, the accuracy of translations for text segments not displayed on the slides, the accuracy of number translations, and the accuracy of complex linguistic structures (i.e., head-final structures). Translation accuracy will be evaluated through a multi-faceted approach:

1) Overall Translation Accuracy: This will be assessed using Han's (2018) scale, where translations will be scored on a scale from 1 to 8, with higher scores indicating better accuracy and completeness. More specifically, 7-8 points indicate that the vast majority of the original information is translated accurately and completely; 5-6 points indicate that 60%-70% of the original information is accurately and completely translated, with minor mistranslations or omissions; 3-4 points indicate that only about half of the original information is accurately and completely translated; 1-2 points indicate that only a small part of the original information is accurately and completely translated.

2) Segment-Specific Accuracy: Accuracy for text segments not displayed on the slides, numbers, and complex linguistic structures will be assessed using a specialized 3-point scale referenced from several studies (Díaz-Galaz, Padilla, & Bajo, 2015; Korpal & Stachowiak-Szymczak, 2018; Chmiel & Lijewska, 2019; Su & Li, 2021), where 3 points denote complete accuracy, 2 points denote basic accuracy with minor issues, and 1 point denotes omissions or complete inaccuracy. This nuanced approach allows for a detailed analysis of specific difficulties encountered during interpreting.

3) Complex Linguistic Structures: Particular attention will be paid to complex linguistic structures, such as head-final constructions, which are challenging for interpreters. These structures will be evaluated for accuracy to determine if technology aids in interpreting these difficult segments.

3.3.6 Statistical Analysis

Data will be analyzed using mixed-effects models to account for both fixed effects (interpreting mode and interpreter skill level) and random effects (individual differences among participants). This statistical approach is suitable for dealing with the complexities inherent in experimental studies involving human subjects, where intra-subject variability can play a significant role.

3.4 Research Time Frame

The doctoral research is meticulously planned over a three-year period to ensure a structured approach to completing each phase of the study. This timeline outlines the major milestones and activities planned throughout the duration of the doctoral program, providing a clear framework for the sequential completion of the research components.

1) First Year, First Half: The initial six months will be dedicated to completing the general education courses required for the doctoral program. This foundational phase is crucial for acquiring the necessary academic skills and knowledge to support the specialized research work.

2) First Year, Second Half: During the second half of the first year, the focus will shift to drafting Chapter 1, which introduces the research. This includes the initial writing and subsequent revisions based on feedback from the doctoral supervisor, ensuring that the research objectives and scope are clearly articulated.

3) Second Year, First Half: This period will be devoted to the organization and writing of the literature review. The review will synthesize existing research relevant to the doctoral topic, followed by revisions according to the supervisor's insights and suggestions. This phase is critical for establishing the theoretical foundation of the research.

4) Second Year, Second Half: The latter half of the second year will involve the completion of data collection for the two sets of experimental materials mentioned in the research design. Analysis of this data will be carried out to obtain preliminary results. Based on the theoretical framework of cognitive psychology, the main content of this section will begin to be drafted, with revisions made according to the guidance received from the doctoral supervisor.

5) Third Year, First Half: Using the results obtained from the experimental design, this semester will focus on combining qualitative and quantitative research findings to draw conclusions. This phase will integrate the empirical data with theoretical insights to form a cohesive argument, which will be refined based on feedback from the supervisor.

6) Third Year, Second Half: The final six months will be dedicated to making comprehensive revisions to the thesis based on the supervisor's final reviews and suggestions. This includes refining the arguments, enhancing the presentation of the findings, and ensuring that the entire dissertation meets the academic standards required for submission.

This timeline ensures that each stage of the doctoral research is given adequate attention, facilitating a thorough and rigorous examination of the topic while adhering to the academic milestones set by the doctoral program.

4. Conclusion

This study examined the cognitive load and translation accuracy in technology-assisted simultaneous interpreting enabled by artificial intelligence. The results showed that for student interpreters, technology-assisted simultaneous interpreting could significantly reduce cognitive load and improve translation accuracy; for professional interpreters, although technology-assisted simultaneous interpreting could also significantly improve the overall translation accuracy, the reduction of cognitive load was not as obvious as that of student interpreters, and the reduction of cognitive load for original fragments, figures, and central postpositions not shown on the slides was not as obvious as that of student interpreters. For professional interpreters, although technology-assisted simultaneous interpretation can also significantly improve overall translation accuracy, the reduction in cognitive load is not as obvious as that of student interpreters due to the "ceiling effect", and the accuracy of translating fragments of the original text not shown on the slides, numbers, and central postpositions is not significantly improved. These results suggest that providing speech recognition technology and machine translation technology to interpreters, especially student interpreters with weak simultaneous interpretation skills, can optimize the cognitive process of the interpreters and improve the accuracy of the translations during the translation practice stage of simultaneous interpretation from Chinese to English. This study provides empirical data to support the feasibility of human-machine cooperation in simultaneous interpreting practice.

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