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Cognitive Aspects of Translation: The Latest Research in Psycholinguistics and Cognitive Science

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ABSTRACT

The study of the cognitive aspect of translation opens up new possibilities for understanding and analysing the translation process through the prism of cognitive science. By analysing the cognitive processes that take place in the translator’s brain while performing translation, it is possible to reveal various aspects of this complex and multifaceted process. The purpose of this article is to conduct a literature review of cognition-oriented translation studies in order to contribute to the development of the science of translation studies. The method included the analysis of related literature from the scientific databases Scopus and Google Scholar. As a result of this study, advanced theoretical models were put forward and developed to reveal the so-called “black box” of the translator, which is considered a key aspect in

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understanding the cognitive processes of translation. These theoretical approaches aimed to uncover the internal mechanism and strategies used by the translator when performing translation in order to reveal and analyse how these processes occur in the translator's brain. Conclusions – the research focused on translation processes has great potential, as it uses the latest theoretical models and research methods from related cognitive disciplines such as cognitive psychology, cognitive linguistics, neurophysiology and computational linguistics. The paper attempts to identify challenges in cognitive translation research in order to contribute to a broader understanding of the cognitive aspects of translation and to help address key challenges in this area.

Keywords: Translation processes; Psycholinguistics; Text comprehension; Bilingualism and cognition; Experimental psycholinguistics

1. Introduction

Translation has existed for thousands of years and plays a key role in communication and knowledge exchange between different cultures and languages. Despite the long history of translation, understanding the complexities and peculiarities of this process continues to be a subject of interest to researchers from all over the world (Tarasova et al., 2023). This is for several reasons that reflect the significance and importance of translation in the modern world. Considering translation as a mental activity, scholars have begun to pay attention to the cognitive aspects of this process, as it is an ideal object for studying the ways in which language and information are represented in the mind (House, 2019). According to Ponsonnet (2022), translation involves two main stages: understanding the source language and producing the target language. These two stages reflect the complex cognitive processes that take place in the translator's brain when converting information from one language to another.

Undoubtedly, understanding the source language requires analysing the text and interpreting it with regard to linguistic, semantic and contextual aspects (Henriksen et al., 2020). During this stage, the translator must uncover the meaning of the text and understand its ideas and intentions.

Target language production involves the transformation of comprehensible information into text in the target language, taking into account the cultural, grammatical and stylistic features of the target language (Abukhalaf & von Meding, 2021). This stage includes the selection of appropriate words, grammatical structures, and stylistic devices to reproduce information in the form of comprehensible text for the reader.

Research on the cognitive aspects of translation aims to understand and analyse these complex processes in the

translator's brain, which can lead to the development of new techniques and strategies to improve translation quality and efficiency (Altarriba & Basnight-Brown, 2022). According to Beibei (2023), comprehension refers to the mental process by which a translator constructs meaning in his or her brain using primitive visual elements. Production in the target language refers to the process by which the translator re-expresses the meaning of the source language constructed in his or her brain using the form of the target language. We believe that in the process of understanding the source language and producing the target language, the translator's lexical level and encyclopaedic knowledge, as well as the inference of knowledge-based thinking, play an important role.

Cognitive science actively engages an interdisciplinary approach to studying mental processes (Onyshchenko et al., 2023). She uses methods and concepts from anthropology, artificial intelligence, linguistics, neuroscience, philosophy, and psychology to analyse how information is processed and transformed in the brain through perception, language, memory, and thinking (Zhurakhovska, 2023). In addition, it explores how machines perform tasks that mimic human cognitive functions by using certain language, memory, and thinking mechanisms, including in translation (Huang & Agbanyo, 2022). Despite the long history of translation, understanding the complexities and peculiarities of this process continues to be a subject of interest to researchers from all over the world. In this context, the paper highlights the working issues that will reveal the meaning and importance of translation in the modern world.

WP 1: What new research in psycholinguistics and cognitive science is exploring the cognitive aspects of translation?

RP 2: At the stage of translation comprehension, should

the information be processed first through a syntactic analyzer, then a semantic analyzer, and then a pragmatic analyzer?

WP 3: What is the observable and inferred cognitive processes that translators use to produce their translations?

In addition, it should be noted that the expansion of the global market for translation and localisation services has generated increased interest in research in this area. Professional translators, linguists, psychologists and other specialists understand the importance of developing new techniques and strategies to improve the translation process.

Therefore, understanding and studying the processes of translation and interpretation is nowadays critical for the further development of communication, understanding and cooperation between different cultures and languages.

2. Materials and methods

In the present paper, a comprehensive review of recent research in the fields of psycholinguistics and cognitive science was conducted to collect relevant studies on the cognitive aspects of translation. The methodological basis of this study is the analysis of related literature, forecasting, modelling and systematisation. The first stage of the study included a description of the content of information by topic and keywords: linguistics, hermeneutics, bilinguals, means of translation, psycholinguistics, cognitive science. For an in-depth analysis of the proposed issues, 40 scientific articles were selected. This included accessing academic databases such as Scopus and Google Scholar in order to identify peer-reviewed articles, books and research papers published in the last five years. The selection of materials was based on their relevance to the cognitive processes involved in translation, including attention, memory, decision-making, and problem solving.

A literature review was conducted using the Evidence for Policy and Practice Information and Co-ordination research methodology, which allowed us to identify relevant articles as accurately as possible, summarise the information collected by topic, and divide the research into smaller topics: translation, psycholinguistics, modern traductology, cognitive science (**Table 1**).

To answer the research questions, a systematic review was conducted using content analysis. The systematic lit-

erature review comprehensively identified, evaluated and synthesised all relevant studies on the topic. The number of articles found in the identified databases and the descriptors used helped to identify the research questions.

Only studies that directly addressed the cognitive aspects of translation were included, while those that focused solely on linguistic or technical aspects were excluded. Data from the selected studies were extracted and organised based on key themes and findings related to cognitive processes in translation. This included a summary of research methods, experimental designs, participant characteristics, and main findings. The data were analysed to identify patterns, trends and gaps in the existing literature on cognitive aspects of translation. This included comparing and synthesising findings from different studies to gain insights into the cognitive mechanisms underlying the translation process.

The findings were used to develop a comprehensive understanding of the current state of research in cognitive translation studies. This included a critical assessment of the strengths and weaknesses of existing methodologies and suggestions for future research in the field.

3. Results and discussion

In today's world, there is a growing interest in researching the cognitive aspects of the translation process. This interest is stimulated not only by the importance of intercultural communication in the context of globalisation, but also by the rapid development of technologies, in particular machine learning and artificial intelligence. This study analyses the challenges faced in cognitive translation research in order to identify potential areas of development in this field.

The identified challenges cover a wide range of aspects, including but not limited to the complexity of modelling cognitive processes in translation, the ambiguity in defining and measuring cognitive parameters, and the need to integrate the latest technologies into research.

For the further development of cognitive research in the field of translation, we have proposed several potential directions. Among them is the expansion of the research spectrum to include interdisciplinary approaches such as computational linguistics, neurolinguistics and artificial intelligence. Additionally, the development of innovative research methods, such as functional magnetic resonance imaging (fMRI)

Table 1. Main authors chosen by EPPI.

Key word	Direction	Description	Representatives
1	Translation	Describes prescriptive methodology, which includes pedagogical and empirical research, as well as literary or philosophical aspects.	Saint Augustine, Saint Jeremiah, Cicero, Etienne Dole, Roger Zuber (Tianzhen, 2023)
2	Psycholinguistics.	It covers any language product, whether descriptive or contrastive. This stage is sometimes referred to as “traductology yesterday”.	Vinay and Darbelne, Fyodorov, J. (2023).
3	Modern traductology	It is aimed at facilitating the work of translators. The aim is to provide a theoretical basis for improving the quality of translation.	M. Lederer, D. Seleskovic, M. Ballard, J. Desil, E. Nida (Tianzhen, 2023)
4	Cognitive science	It is aimed at experimental study from the point of view of cognitive psycholinguistics.	J.-R. Ladmiral, I. Oseki-Depreux, J.C. Guémard (Tianzhen, 2023)

and electroencephalography (EEG), is an important area for direct observation of cognitive processes in translation.

3.1 History of the study of cognitive aspects of translation

The study of the cognitive aspects of translation is constantly evolving, covering a wide range of areas. In this context, it is important to consider the four stages in the history of translation studies identified by Ladmiral (2012): the pre-cultural stage of traductology is a landmark of the past; descriptive trajectory or transitional phase; productive traductology or modern traductology; inductive or scientific methodology.

The fourth stage of traductology, as Ladmiral (2012) defines it, is based on the principles of cognitive science. This stage, known as inductive or scientific traductology, focuses on the scientific study of what happens in the mental space, in particular in the translator’s brain. Ladmiral sees this stage as the traductology of tomorrow, as it opens up new horizons for understanding and analysing translation.

Given the complexity of the phenomena being defined, this stage may be more in line with the trajectory of the day after tomorrow. It reflects the rapid development of scientific methods and technologies that allow for a deeper and more accurate study of the cognitive processes involved in translation. This approach opens up new perspectives for researching and understanding the principles of the functioning of the language mechanism in translators, and distinguishes between internal and external translation. In this context, scholars classify translation research into two types: external

and internal.

Translation as a social and cognitive process

Dizdar & Rozmysłowicz (2023) consider the translation process as a social (external) and cognitive (internal) activity at the same time. The former, in which traditional translation studies fit, focuses on translation methods, standards and functions related to translation products. The second, which can be called cognitive translation research, focuses on the translation process, aiming to create a model of translation based on psychological reality and identify psychological mechanisms of translation, which allows describing and explaining how comprehension, decision-making and reverberation strategies occur in the brain of a bilingual translator. Duong, Nguyen Hong, Duong Tuan, Bui Uyen & Tran Thi Tra (2024) believe that “an internal system needs to be made external by modelling it”.

Cognitive (psycholinguistic) models of translation

In the cognitive (psycholinguistic) model of Boyd & Schwartz (2021), the translator’s brain functions as an “information processing system” where the translation process results from the interaction between intuitive and controlled processes that use linguistic and extra-linguistic information. Based on a number of cases, the authors demonstrate that the translation process is a combination of unobservable controlled and uncontrolled processes.

However, it should be noted that models of the cognitive process of translation today are marked by a large number of more or less complex models: naturalisation (strategy of domestic) and remoteness (strategy of foreigner).

Proponents of both extreme positions are respectively called target and source interpreters (Dando et al., 2023). One model among many is the “heuristic translation process” proposed by Delisle (1979). Today, the followers of his idea interpret interpretation as a way by which the meaning of a word, phrase or whole text is achieved (Dewi et al., 2022). Translation is an interpretive exercise, an intelligent analysis of discourse (Delille, 1980, p. 65). Proponents of heuristic translation try to show that the construction of meaning does not stem only from the sum of the linguistic meanings used (the textual mass), but it arises from the interaction of this linguistic information and the translator’s cognitive base (his/her encyclopedic knowledge), as well as situational and contextual parameters, in short, extra-linguistic information (Dey & Sawalmeh, 2021).

Logically, the heuristic process of translation can be seen as a sequence of three distinct phases: comprehension, reformulation and verification, as described by Delisle (1979). Comprehension occurs through the interaction between linguistic meaning and nonlinguistic reality. Reformulation of ideas extracted from the source text for translation occurs through the transformation of abstract meaning into accessible linguistic forms for its expression. Validation entails a second interpretation of the message to be translated, which allows for an informed choice among temporary solutions. According to Pokharel et al. (2024), interpretation involves a constant transition between the linguistic meanings of the source text and the concepts being defined (first interpretation), and between these concepts and the linguistic meanings of the target text most suitable for their expression (second interpretation).

In 2024, Moneus & Sahari (2024) presented a mind model for simulating the translation process using artificial intelligence, bordering on “mapping theory” Hönig (1991). In this model, where translation is carried out using artificial intelligence, scientists see similar processes in a machine and a bio-translator. It is important to have two maps - a map of the original text in our minds or in the system and a map of the genre of the text we are trying to create in the target language. Even in the case of consecutive translation, this structural concept remains relevant because each phrase in the translation is formed not only from the source text, but also from both maps - the source and the translated text - which are used to support the translation process (Carl &

Schaeffer, 2019).

In this aspect, the authors describe how the original text is transformed into an object of understanding for the translator, based on the fact that it is “removed” from its natural context and recreated in the translator’s mental reality. This process involves two processing modes: controlled and uncontrolled workspaces. In the unsupervised workspace, there is an initial understanding of the text, which is used to form frameworks and schemas, as well as to create a set of semantic patterns based on the translator’s perception (Metu et al., 2024).

The theory of meanings or levels of translation is new in the cognitive approach to the study of translation. Marais (2024b) has done pioneering work on the analysis of interpretation. The author identifies three interconnected levels of the translation/interpretation process: (1) comprehension, (2) de-verbalisation, and (3) re-expression. This theory describes the process of interpretation and translation as the re-expression of textual meaning through its subsequent de-verbalisation and re-verbalisation in the target language. We agree, because in verbal communication, linguistic forms disappear, leaving behind the consciousness of meaning that can be spontaneously expressed in the target language. Meaning, then, can be defined as a non-verbal mental representation that emerges in the interpreter’s mind as a result of the interaction between linguistic meaning and world knowledge (cognitive applications).

In order to separate the meaning from the words of the source language, Makurat-Snuzik (2024) recommends that the interpreter visualise the images that the text presents. Mentally seeing the object or event seemed to help them understand the meaning. Visualisation in this respect is a technique, a pedagogical tool to help students understand the meaning and forget the words of the text source. The author describes interpretation as a process in three stages (**Figure 1**).

This notion of meaning as a mental representation separated from language can be accurately expressed in any target language, but in our opinion, this formula provides a somewhat idealised view of the interpretation process.

The results of research in the field of psycholinguistics show that bilinguals cannot clearly distinguish between two languages. A large number of translation experts believe that translators primarily rely on formal correspondences

between languages and look for alternatives only when literal interpretations fail to produce the desired result (Amin, 2022).



Figure 1. The notion of meaning as a mental representation separated from language.

Thus, the literature review shows that cognitive models of interpretation and translation are currently being developed to meet pedagogical needs and are not intended to accurately describe cognitive processes (Sulaiman AlSuhaim, 2024). However, it has been criticised that such models cannot be considered as pedagogical paradigms, but rather as descriptive scientific theories (Inyang et al., 2022). However, it is suggested for use in the interpretation and translation classroom to avoid literal translations and encourage learners to reformulate the source text.

Modern cognitive translation can be viewed as a triangular process that includes the stages of signs, non-verbal phase and reverberation. This model differs from interlanguage translation, which is often known as “transcoding” or “matching”. The latter involves the use of decontextualised equivalents to preserve the meaning of the text at the linguistic level.

Thus, modern research in the field of translation is increasingly focusing on the analysis of corpora of speech samples and their subsequent interpretation. Studies have shown that interpreters actively capture certain elements, such as numbers, lists and technical terms. These elements, known as “transcoding” elements, need to be captured for later use because they do not require interpretation and do not interfere with the memory process. However, even with the widespread use of artificial intelligence, the role of the translator and their cognitive capabilities remain an integral part of an effective translation process.

4. Discussion

Contemporary scholars in the field of translation, cognitive linguistics, and psycholinguistics present models of the translation process based on linguistic and psycholinguistic views, divided into phases of analysis and synthesis (Heydel, 2024). Some of them use elements of artificial intelligence

in their structural organisation and adopt the framework of system-functional linguistics. Thus, in terms of the first RQ, authors state, that new research in psycholinguistics and cognitive science is exploring how translators process and manipulate language on a cognitive level, how they make decisions during the translation process, how they manage cognitive load, and how they engage with different linguistic features in the source and target languages (Songaila, 2024).

The analysis of the available literature allowed us to generalise the translation process and formulate the hypothesis that translation, as a cognitive process, consists of three stages (**Figure 2**). The first stage involves analysing the source language text in terms of universal semantic representation (i.e., the source language) in terms of a nonspecific mental image. The next step is the synthesis of this semantic representation into a language-specific text (target language text), and the third step is the synthesis of the language-specific text (target language text).

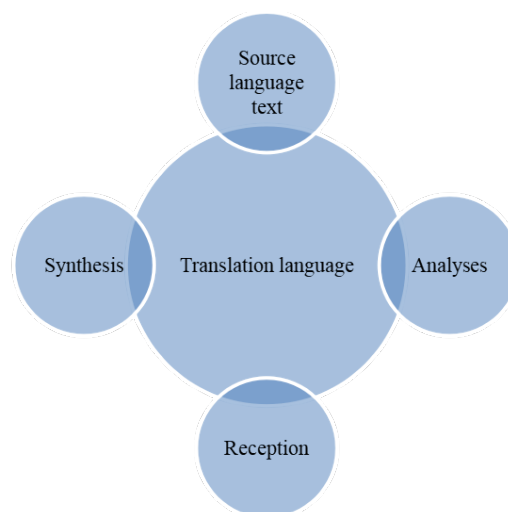


Figure 2. A generalised model of the translation process.

The presented model of the translation process is based on the following assumptions. We believe that the translation process is a special case of information processing that can be described by the theory of psychological information processing (Costa et al., 2017). In answering Working Question 1, it should be noted that in the process of translation, the translator must use semantic representations that are not limited to any language as an intermediary to decode the source text and encode the text in the target language, so that the whole process takes place in short-term and long-term memory. Whether it is in the input analysis stage or the output synthesis stage, text processing should be done

in a top-down or bottom-up manner, with each sub-process interacting with the other.

In a related study, Cheyette et al., (2024) describe the translation process as involving a visual word recognition system, a spelling system divided into two parts: analysis and synthesis, i.e., the analysis and synthesis stage. It could answer the second RQ. Translation comprehension should involve processing information through different analyzers like a syntactic analyzer, semantic analyzer, and pragmatic analyzer in a sequential manner to ensure a comprehensive understanding of the text and to produce an accurate translation. This roughly corresponds to the understanding and expressiveness in traditional translation studies (Korhonen, 2024). In this case, the entire translation process is carried out in the memory system, although the input data must be processed at the syntactic, semantic and pragmatic levels. We believe that in such a schematisation, there is no fixed order set in advance, and there is always the possibility of regression, which allows for constant revision and changes to previous decisions.

Unlike previous authors who compare translation activity to “steps to be climbed”, Castro-Alonso et al. (2024) use the term “freezing”. During the translation process, the source language text is “unfrozen” (i.e., analysed to create a semantic representation). Each molecule moves and changes its place, some even go beyond the boundaries, and new ones are poured in to fill the spaces. When the target language text is synthesised, it becomes a new ice floe that is different from the original but appears to be the same.

The brain and its internal mechanism and working principle can only be discovered from the relationship between input and output (Alves & da Silva, 2021). Many experiments show that human information processing is sequential in general, but also includes parallel processing. The latest research in psycholinguistics and cognitive science is based on the sequential method of information processing.

Although modern theories provide a deeper understanding of the translation process than before, we cannot say that modern cognitive models of translation fully reflect the psychological reality of the translator (Marais, 2024a). For example, to answer RQ 2: in the comprehension stage of translation, should information processing first go through a parser, then a semantic analyser, and then a pragmatic analyser? If we follow a parallel path of information processing,

we can provide an answer in a different direction from this.

In terms of the third RQ the observable and inferred cognitive processes that translators use to produce their translations include but are not limited to: identifying and understanding the source text, making decisions about the linguistic and cultural nuances of the source text, formulating strategies for translating complex language structures, managing working memory and attention, monitoring and evaluating the translation process, and adjusting translations as needed to ensure accuracy and naturalness in the target language. Translation process research is a branch of translation studies that operates within the methodological paradigm of experimental cognitive-behavioural research, where the main data on the translation process is obtained from the keyboard activity and eye movements of translators. This paradigm is often extended with data collected during various expressive sessions, such as simultaneous or retrospective reflection sessions, interviews, or questionnaire responses (Sannholm & Risku, 2024).

In some cases, more high-tech methods are used, such as electroencephalography (EEG) or functional magnetic resonance imaging (fMRI) (O’Brien, 2024). Regardless of the combination of data collection methods, the research on translation processes seeks to answer research question 3: What observable and predictable cognitive processes do translators use to produce their translations?

To summarise, in recent years, understanding cognitive processes has become a constant goal in translation research. Modern scholars propose models that are mainly based on the results of “thinking aloud protocols as a window into human thinking”.

5. Conclusion

Compared to the past, when the main focus was on an imaginary theoretical approach to the translation process, the first two decades of the 21st century brought significant progress in innovative data collection methods. This has led to an increase in interdisciplinarity in research approaches and the formation of large-scale research communities.

Given the above, the translation process is a complex cognitive process that is recursive and iterative, with various factors playing an important role. The intrinsic complexity of the translation process is further enhanced by the fact that

various factors can influence its course, depending on the personality of the translator, the purpose of the translation, the method chosen and the type of translation (e.g., legal, literary, technical, audiovisual, etc.). In this context, thorough empirical studies of the translation process in different translation modalities should provide reliable information about the specifics of each cognitive operation, their commonalities and differences. This is one of the main challenges of studying the nature of the translation process. A deeper understanding of these aspects will help us to better understand the characteristics of the translation process as a whole.

We should be aware of all the challenges that arise in connection with cognitive approaches to translation, including theoretical model building, methodological evaluation, data documentation and subject matter clarification. These challenges also determine the direction of further development in the field of cognitive translation research.

Despite the significant progress in the study of cognitive aspects of translation, there are certain limitations to the work presented here. Many studies in this area use different methods and approaches, which makes it difficult to compare results and generalise findings. Most studies are conducted on limited samples of translators or texts, which may limit the overall support and applicability of the findings. Furthermore, studies focus exclusively on theoretical aspects, without taking into account practical aspects that can have a significant impact on the actual translation process.

Further research into the cognitive aspects of translation can reveal a lot of new things in the context of psycholinguistics and cognitive science. In our opinion, the study of the decision-making process in translation and the development of cognitive translation models would be promising. After all, further improvement and development of models that describe the cognitive processes of translation can contribute to a better understanding and prediction of translators' behaviour.

Author Contributions

Conceptualization, Mykhailo Zhylin and Nataliia Popova; methodology, Solomiya Antonyuk-Kyrychenko; software, Maryna Harbar; validation, Nataliia Yuhan, and Mykhailo Zhylin; formal analysis, Nataliia Popova; investigation, Maryna Harbar; resources, Nataliia Yuhan; data

curation, Solomiya Antonyuk-Kyrychenko; writing—original draft preparation, Maryna Harbar; writing—review and editing, Nataliia Yuhan; visualization, Mykhailo Zhylin; supervision, Nataliia Popova; project administration, Solomiya Antonyuk-Kyrychenko. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

There is no conflict of interest.

Data Availability Statement

In the present paper, a comprehensive review of recent research in the fields of psycholinguistics and cognitive science was conducted to collect relevant studies on the cognitive aspects of translation. This included accessing academic databases such as Scopus, Google Scholar and Research Gate to identify peer-reviewed articles, books and research papers published in the last five years. The selection of materials was based on their relevance to the cognitive processes involved in translation, including attention, memory, decision-making, and problem solving.

Only studies that directly addressed the cognitive aspects of translation were included, while those that focused solely on linguistic or technical aspects were excluded.

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