

Geno-Translation Conception and Mechanisms

BENZERGA NOUR EDDINE*

University of Oran1 Institute of

Translation, Algeria

noureddine_benz@yahoo.com

Received : 14/04/2026

accepted: 12/05/2026

Abstract:

This research paper intends to study the concept of Geno-Translation by demonstrating the behavioral scientific aspects and genetic factors that govern the process of teaching and learning translation science, whether for university students or professional translators. It is known that the issue of learning any type of knowledge and science requires a link between the behavioral psychological aspect and educational ability, which requires the recipient's faculty to receive knowledge and acquire new skills. Therefore, this study came to answer the questions raised: Does genetics play a part in speeding up the process of learning a language and producing expert translators, and is learners' educational capacity crucial to the development of a translator's personality, cognitive talents, and language skills? These questions requires a deep research to access to the real evidence analysis of geno-translation to understand its mechanisms in decision-making and to benefit from its innovative techniques, particularly in applied translation studies.

Keywords:

Geno-Translation –Educability –Neurolinguistic- -Translation mechanisms -Training

Introduction

The significant change in translation education was brought about by Delisle, Jean, more than thirty years ago. His work mainly concentrated on the appropriate translation process in this type of instruction; he suggested learning goals and a pedagogical strategy intended to motivate students to take an active role in their education. These ideas have inspired a lot of translator trainers (Amparo Hurtado Albir,, 2015,p.290). Compared to the state of adjacent subjects like language training, there is still more work to be done even though research on the kind of translation instruction Delisle discussed has recently improved.

New curriculum that satisfies societal demands had to be created as a result of modifications in the translation's training. Furthermore, new pedagogical models that support competency-based training and an integrated approach (Erika Levine, Susan Patrick, 2019,p.03) to teaching, learning, and assessment cannot be disregarded in translator training. However, studying translation is a hard endeavor that involves many cognitive and high-level mental activities. Biologically, translation ability allows behavioral reactions to gradually change, altering elements that might help the translator survive in such complicated mental activities. The brain can overcome challenges and

* The corresponding author: BENZERGA NOUR EDDINE

learn new abilities and concepts throughout life, engaging dynamically with the environment.

Studying translation takes in consideration this ability to learn, and it should maximize cognitive processes while taking human culture into account. In other words, translation education should help develop students who can change themselves through self-directed active learning throughout their life, depending on the particular historical and social environment. These well-educated students should also be prepared to expand their knowledge and skills to the fullest extent possible, thereby developing both academically and emotionally.

Therefore, in order to fully comprehend the mechanics of Geno-translation, we must examine the following relevant points:

1. Translation and the neurological mechanisms:

1.1. Translation neurocognitive and Behavior (TNB):

Translation is not just an interlinguistic game of replacing the source language text with target language text including cultural and educational nuances; but it is a complex process that can shape the options and attitudes of recipients. Moreover, translations are never produced in a cultural or scientific vacuum and cannot be isolated from the context in which the texts are embedded .

The translator is a bilingual mediating agent between monolingual communication participants in two different language communities. Therefore, translators not only have to be intermediaries between different language systems, but also have to be intercultural mediators so, thus the translator's brain must be able to identify and evaluate emotions.

The way a sentence is translated can be significantly influenced by its emotional meaning. For instance, depending on the circumstance and context, a statement like "I love you" could indicate quite different things (Alejandra Fonseca, 2023, p. 02). For this reason, it is crucial for translators to understand how culture affects language and how emotion might affect their behavior and neurocognitive processes.

Translation, Neurocognitive and Behavior (TNB) is a new field of study that focuses on cognitive translation studies, including both novel and conventional methods of comprehending the mental processes involved in translation (Elena Davitti, Alper Kumcu, 2024, p.158). This study focuses on a field of study commonly referred to as "neurological translation studies," which encompasses both conventional translation process research and new conceptual paradigms being investigated in cognitive translatology.

Philosophy, cognitive science, psychology, bilingualism studies, anthropology, artificial intelligence, ergonomics, and any other field that can shed light on the complex observable behavior of cross-language communication are all intertwined with neurological translation studies. Translation learning may be influenced by general intellect and cognitive skills, but these traits are not always inherited. Learning and practice can enhance one's intelligence and cognitive skills.

Research on the neurological process of translation also shows that the right hemisphere of the brain initially considers word structure, including syntax and grammar. In order to produce a suitable translation, it then integrates this data with context, memories, and cultural knowledge. In order to concentrate on both the meaning of the words and the

context in which they are being used, this extended neurocognitive system requires a high degree of cognitive control.

Chiefly, the neurology of translation is an intriguing area that demands rigorous analysis of language and cognitive processes in order to produce meaningful translations. We can better understand how to create good translations that accurately convey the original content by examining how the brain processes language and considers context, culture, and emotion (Elena Davitti, Alper Kumcu., 2024, p. 159).

We may ask whether a longer period of work or training with this heavy cognitive load will lead to some neurofunctional adaptation in the brain of the trainee translator/interpreter. In fact, the research on the (interpreting) expertise-induced cognitive and neural adaptations has just begun.

1.2.The translation's neurological process:

Translation's neurolinguistic* approach basically treats the neurological function mechanisms of bilingual operations in the field of interpreting and translation process. Moreover, the bilingual complex and cognitive process are involved in the translation process, which contains various operations of the language and cognitive control, such as language input, lexical access, semantic and knowledge retrieval, code-switching, self-monitoring and self-correction in language production, language output, and so on (Lin Zhu, 2023, p. 02). The neurocognitive research on the above-mentioned bilingual processing sub-processes, therefore, becomes the major task of the neurolinguistic approach to translation studies.

One of the most fundamental components of translation is the neurofunctional circuit of language switching, but it's also needs a range of neurofunctional organizations , that means it's involving multiple layers of bilingual and cognitive processing such as :

1. phonetic,
2. lexical,
3. semantic and syntactic layers,

which needs to be performed by complex neurofunctional organizations. Furthermore, translation or interpreting neurocognition research has been based on the methods of comparing the electrophysiological or neuroimaging results of translating/interpreting and other monolingual activities such as:

1. reading,
2. silent reading,
3. shadowing in order to investigate the neural correlates and cognitive process involved in translating or interpreting (Lin Zhu, 2023, p. 04).

In addition, it was pointed out that language proficiency may affect the use of inhibitory control and that language control is a complex process that may rely on different mechanisms such as Neurological Bilingual for different languages.

* the study of the relationships between the human nervous system and language especially with respect to the correspondence between disorders of language and the nervous system.

1.3 Translation Neurological Bilingual Switching Issues:

As mentioned above, compared with monolingual processing, bilingual processing in the translation process involves more complex language control and switching. If language switching in bilinguals involves a 'prefrontal-ACC-caudate-SMA'* (Andrew Jahn, Derek Evan Nee, 2016) neurofunctional system, this system, theoretically, should be also involved in the translation process. This point has also been demonstrated by some neurocognitive translation studies.

And thus, neurocognitive research on translation and language code switching to some extent sheds light on bilingual switching in translation (Adolfo M. García, (2019), p. 55). Theoretically, language switching needs a larger cognitive cost than the non-switching situation at the same level of language performance due to that it needs more attentional control of the two languages in competition.

In addition in the translation process, bilingual switching/shuttling involves semantic processing while for non-translating bilinguals code switching does not, but involves the inhibition of a language not in use.

The above hypotheses about the neurofunctionally independent systems of translation are rooted in the clinical case studies of translation disorder of the bilingual aphasics who performed controlled tasks with decontextualized stimuli. It is still early to draw any conclusion about the neurocognition of translation just from those studies and thus what the various translation disorder phenomena really suggest is still in the air. Hence, the following question can be raised: Is the translator genetically qualified to learn and to be a professional translator?

2. Geno-Translation Conception:

The study of the genetic underpinnings of translational behaviors and dispositions is what we refer to as "GenoTranslation." It integrates behavioral genetics, psychology, and translational science and is closely related to new fields like translational physiology (the study of biophysical relationships to translational behaviors and tendencies) and neurotranslation (the study of the neural basis of translational behaviors and tendencies). Genetics has a big impact on both the ability to learn and the particular language learning experience in the subject of translation learning.

Variations in genes like COMT and BDNF* (Wen Chen ,Chunhui Chen ,Al, 2016) have been linked to differences in language learning outcomes and the efficiency of neural

* The term "prefrontal-ACC-caudate-SMA" refers to a network of brain regions – the prefrontal cortex, anterior cingulate cortex (ACC), caudate nucleus, and supplementary motor area (SMA) – that are frequently implicated in cognitive control and executive functions. These areas work together to help regulate thoughts, actions, and emotions, particularly in situations requiring attention, decision-making, and error monitoring, Andrew Jahn, Derek Evan Nee, Distinct Regions within Medial Prefrontal Cortex Process Pain and Cognition.

* COMT and BDNF genes can interact to influence brain function and behavior. For example, studies have shown that these genes interact to affect cognitive functions like working memory and emotional regulation.

processing during language tasks. Furthermore, genetic factors can influence the brain's structure and function, impacting the speed and accuracy of language acquisition (Molly McElroy, 2016).

2.1 Specific Geno-Translation factors and their influence:

When we talk about translation we switch on the subject of Language acquisition which involves the natural processes by which translators acquire the ability to use language and assimilate it, including capacities to perceive, comprehend, and produce the translation in the target language. This subject has been widely studied by types of environmental exposition and language input, and genetics lately, due to the rapid development of gene analysis (Wolfgang Klein, 2010).

In the mid 20th century, the human genetics deep studying has given investigators in the field of translation and language acquisition the chance to look at the genetic components of language learning. Early genetic studies involving language were based on the theory of Mendelian genetics (Hilda Geiringer, 1945, p. 25) of inherited traits.

These studies have primarily analyzed family pedigrees affected by speech and language disorders to deduce heritability trends. With the advent of more cost-effective and reliable methods for investigating molecular pathways, researchers can now pinpoint specific genes linked to language function and disorders. Although genetic influences are present in most, if not all, cognitive functions related to learning, the precise identification and specific impact of each gene and allele on various learning aspects remain exceedingly challenging due to certain complicating factors in mental life:

1. The large number of genes involved,
2. The typically intricate gene connections,
3. The potential for any gene, or even any allelic system, to affect many psychological domains (e.g., social facilitation and working memory, as observed for the Val158Met* (Genesight) allelic system of the COMT gene),
4. The impact of many environmental factors, such as social, familiar, and educational settings, on brain processes. For instance, IQ has been found to be influenced by dozens of different genes (Robert Plomin, Sophie von Stumm, 2018).

As previously stated, we are aware that the genes responsible for individual variances in one's native language would differ from those in other languages. In fact, it is possible that native language would be more affected by genetics than foreign languages. For this reason, we might pose the following query to ourselves:

What is so unique about a person's genetic composition that enables them to speak and translate languages fluently?

* The COMT Val158Met polymorphism (rs4680) is a genetic variation in the catechol-O-methyltransferase (COMT) gene that affects how the brain breaks down dopamine, norepinephrine, and epinephrine. It influences cognitive function, emotional regulation, and stress responses.

What effects does genetic ability have on other higher cognitive skills in translation, like language fluency, human memory, and brain activity?

It has been difficult to even ask these kinds of questions until lately. However, techniques for analyzing genes linked to language acquisition and translation activities have advanced quickly in recent years. We can start researching the Geno-Translation foundation of human cognition and, consequently, language in order to have a deeper understanding of this topic.

2.2 Geno-Translation and Individual differences:

2.1. Language -specific effects:

As we know; speed, accuracy, and the capacity to learn several languages are all impacted by genetic variants, which also contribute to the heterogeneity seen in translation and language learning success among translators. Research must take into account both genetic correlations with native language on a continuum of competency level and foreign languages learnt at various stages of life in order to gain a more thorough knowledge of the genetic foundation of translation. We would be better able to determine if developmental and learning variables influence the genetic influences on linguistic functions.

Every language we study and acquire during the course of our lives may include distinct cognitive resources compared to those acquired from infancy, which may have contributed to individual differences in achievement. If so, the genes responsible for individual variances in one's native language would differ from those in other languages. In fact, it is possible that native language would be more affected by genetics than foreign languages.

Long-standing discussions in translation and language acquisition regarding whether learning a native language differs fundamentally from learning a foreign language would be resolved with a deeper understanding. The genes linked to translation functions may be those that support language functions outside from linguistic characteristics, such as :

*All languages require lexical retrieval.

or features unique to a language, like:

*Only a few languages have inflectional morphology (Hua Zhao, Yun Chen, 2016).

In addition, to understand the universal or particular nature of genetic association in language has a concrete consequence in terms of whether the same genetic diagnosis of a language disease can be made for a specific language or any language, that is why Chinese and other non-European languages have been the subject of genetic studies in recent years. Nevertheless, the genetic relationships between two languages within the same population were not investigated in these non-European language research. Because language and population-specific effects frequently co-vary, it is challenging to distinguish between them (Amparo Hurtado Albir, 2015, p. 290).

Looking at genes through evolutionary origins gives a new perspective and possibly new answers about how language is written in the genome. Genetic data is like a historical record on the brain for learning language and translation , like if positive selection for a

certain gene occurred while learning, making the functions of certain genes more apparent.

2.2. Brain structure and function:

Genetic factors can influence brain structure and the efficiency of neural pathways involved in translation and language processing, impacting how individuals perceive and process linguistic information.

The concept of perception itself has drastically changed as neuroscience has discovered more about the human brain. Rather of merely receiving "sense data," it has been demonstrated that experience and culture influence translators' perceptions. This is instantly applicable to translators since what we see and perceive influences what we translate, and audiences' perceptions influence how they interpret translations. Humans differ in their perceptual abilities based only on their physical and neurological capacities.

Additionally, studies on the translation process show that the right hemisphere of the brain initially examines word structures, such as :

- Grammar
- Syntax.

In order to produce a suitable translation, it then integrates this data with context, memories, and cultural knowledge. In order to concentrate on both the meaning of the words and the context in which they are being used, this extended cognitive system requires a high degree of cognitive brain control.

The relationship between brain seeing, interpreting the physiological and biochemical signals, and translating or between seeing and the reception of translation is most noticeable in the domains of culture. How we mentally translate aspects of culture depends on what we see, but in turn how we see and perceive culture depends not just on our physical capacities and our neurological wiring, but also paradoxically on culture itself which influences and shapes perception. That is, there is a recursive relationship between perception and culture (Maria Tymoczko, 2012, p. 87).

The brain translation processes are a priceless tool for bringing people from various backgrounds and cultures together. It is essential to have a genetic pre-understanding of the subtleties of the language and the context in which it is used in order to guarantee accurate translation. We can learn more about how the brain interprets meaning, processes language, and can be used as a translation tool through neuroscience. We can choose translation providers more wisely and produce more accurate and insightful translations by learning how the brain understands language.

Additionally, without restricting source language stimuli to the word or sentence levels, a number of research have examined brain translation mechanisms. In terms of cognitive processes, suprasentential text translation is very different from sentence translation and, more precisely, from word translation. Supra-sentential text translation necessitates the ongoing building of a progressively richer verbal context guiding translation decisions, whereas word translation tasks are decontextualized and can be successfully performed using only lexical declarative memory (Robert Plomin , Sophie von Stumm,, 2018).

Four different neuropathologies that impair bilinguals' ability to translate have been identified as a result of research on interlingual reformulation skills after brain damage:

First, involuntary, uninvited, and instantaneous translation of speech is known as spontaneous translation. An incapacity to interpret voluntarily may accompany this illness. Additionally, reports of spontaneous translation into a language that monolinguals cannot use have been made.

Second, when patients are shown to be unable to translate words willingly in one or both directions, they have been diagnosed with an incapacity to translate. Even when monolingual production abilities remain (relatively) unharmed in one or both languages, this condition may nonetheless manifest.

Third, a rare condition known as paradoxical translation behavior occurs when a patient is able to translate into a language that cannot be produced monolingually but is unable to translate into a language that can.

Finally, instances of translation without comprehension—a condition in which individuals can accurately and confidently translate words or utterances despite not understanding the meaning of the SL expressions—have been described (Adolfo M. García, 2013, p. 372). Furthermore, (Adolfo M. García, (2019), based on his analysis of twenty-one cases of brain-lesioned bilinguals exhibiting translation disorders, puts forward three neurofunctional hypotheses:

1. There may be a dissociation between the routes supporting lexical translation and Those subserving L1 or L2 production;
2. The routes supporting back translation and forward translation are mutually independent;
3. Translation can be performed through either a lexical route or a conceptually-mediated route.

He also puts forward three neuroanatomic hypotheses:

1. The posterior areas implicated in declarative memory are specialized for word (as opposed to sentence)
2. Translation; sentence (as opposed to word)
3. Translation relies critically on procedural memory circuits; translation routes are left-lateralized. (Lin Zhu, 2023, p. 03)

This brain translation disorder indicates that the source language meaning may not be activated in the translation process. Based on the clinical data of bilingual aphasics' various types of translation disorders, 3 neurolinguists put forward the hypothesis that there may exist neurofunctionally independent components subserving l1, l2 and translation. The possible explanation for this hypothesis could be that a cerebral lesion in a bilingual subject may for a certain period selectively inhibit only one component of the translation process such as the inability to translate or make the ability of translation lose control, whereas the other component that is functionally independent such as Environmental Circumstance may help to continue to perform translation without difficulty (LinZhu, 2023, p. 04).

2.3 Environmental influences:

Another important element that might help students/translators reach their full potential, both intellectually and emotionally, is the environment, including the educational one. To put it another way, the brain's creation and functioning are founded on a genetic foundation inside the environment that impacts it to a moderate or high degree, even while the brain is pliable and can be changed through education and everyday experiences, and therefore so can cognitive processes. Therefore, understanding the existence and degree of genetic and epigenetic influences on the development of cognitive functions may enable translation professionals to strive toward more considerate and adaptable procedures. These would emphasize the significance of educational practices as an environmental component that contributes to the possible maximizing of students' skills while accounting for hereditary impacts (David Bueno, 2019).

Finally, what we can actually say is that not all traits are equally amenable to significant change through translation's educational intervention because they are influenced by a wide range of factors, from the numerous genes that may act on a single trait to the convergence of numerous environmental factors, including educational ones as well as individual experiences that are nearly impossible to quantify.

Conclusion

In conclusion, we can say that the findings of our study affirm that the process of translation and interpreting Genetics and linguistic abilities involves a complex bilingual processing and cognitive control. There is some debate about the extent to which genetics affects language abilities in general, but this does not necessarily mean translation ability. which means an inevitable heavy cognitive load in the process. The ability to learn translation or a specific language, or even understanding linguistic rules, may be affected by some genetic factors, but this does not mean that these factors determine the ability to translate from one language to another of each translator.

However, learning translation depends mainly on practice and continuous learning. Acquiring this skill requires exposure to two languages, understanding the nuances between them, and practice converting ideas from one language to another. These are all acquired factors, not inherited. There may be an innate predisposition among some individuals to learn languages in general, but this predisposition does not necessarily guarantee the ability to translate. Translation skill requires a deep understanding of the two cultures that the two languages express in addition to the ability to think analytically and creatively.

References :

- Amparo Hurtado Albir, (2015) The Acquisition of Translation Competence. Competences, Tasks, and Assessment in Translator Training, journal Meta, Volume 60, Number 2.
- See, Erika Levine & Susan Patrick, (2019). What is competency-based education? An updated definition. Vienna, VA: Aurora Institute.
- Alejandra Fonseca, (2023) ,The Neuroscience of Translation: How the Brain Turns Words into Meaning,<https://www.daytranslations.com/blog/the-neuroscience-of-translation>, 12/06/2025, 12h00.

- Elena Davitti, Alper Kumcu ,(2023),Translation, Cognition & Behavior,from:John Benjamins.ePlatform,https://benjamins.com/catalog/tcb?srsltid=AfmBOool3YIakARPAAc oFVN2Dn-RqVYAXQP6RuSof_jkZ7kwTaEJumR0 , 14/06/2025,23H00.
- Lin Zhu,(2023), A dynamic view of the neurocognition of translation: Illustrated by neurocognitive studies of the translation process, Ampersand, Huaqiao University, College of Foreign Languages, Quanzhou, Fujian, China, Volume 11.
- Andrew Jahn, Derek Evan Nee,(2016),Distinct Regions within Medial Prefrontal Cortex Process Pain and Cognition, Journal of Neuroscience, <https://www.jneurosci.org/content/36/49/12385>, 16/06/2025,12h33.
- Adolfo M. García, (2019), The neurocognition of translation and interpreting, Abant Journal of Translation and Interpreting Studies.
- Wen Chen ,Chunhui Chen &Al, Interaction Effects of *BDNF* and *COMT* Genes on Resting-State Brain Activity and Working Memory from; Frontiers in Human Neuroscience. 10.3389/fnhum.2016.00540, 16/06/2025,10:5
- Molly McElroy,(2016) ,Success in second language learning linked to genetic and brain measures ,from ; UNIVERSITY OF WASHINGTON , <https://www.washington.edu/news/2016/06/13/success-in-second-language-learning-linked-to-genetic-and-brain-measures> ,19 /06/2025, 20h55.
- Wolfgang Klein ;(2010), language-genetics <https://www.mpg.de/19395/language-genetics> 02/07/2025 22h33
- Hilda Geiringer, (1945)The Annals of Mathematical Statistics, Institute of Mathematical Statistics , United States ,Vol. 16, No.1
- Robert Plomin, Sophie von Stumm, (2018), The new genetics of intelligence,from:<https://pubmed.ncbi.nlm.nih.gov/29335645>,20/06/2025,20h00.
- Hua Zhao, Yun Chen, (2016),gene polymorphisms are associated with developmental dyslexia in Chinese Uyghur children. from national librery of medicine; <https://pubmed.ncbi.nlm.nih.gov/27098879>, 25/06/2025 ,21h02
- Amparo Hurtado Albir, (2015), The Acquisition of Translation Competence. Competences, Tasks, and Assessment in Translator Training, journal Meta, Volume 60, Number 2.
- Maria Tymoczko, (2012), The neuroscience of translation, University of Massachusetts.
<https://benjamins.com/online/target/articles/target.24.1.06tym?srsltid=AfmBOopIteS1qHefMsqJqfcHJf-eGoucxyzjm3WupAViG-D657oSYtfOu> , 20/06/2025,23h00.
- Robert Plomin , Sophie von Stumm, (2018), The new genetics of intelligence,from:<https://pubmed.ncbi.nlm.nih.gov/29335645>,25/06/2025,00h00.
- Adolfo M. García, (2013),Brain activity during translation: A review of the neuroimaging evidence as a testing ground for clinically-based hypotheses, Journal of Neurolinguistics.
- See, David Bueno, (2019),Genetics and Learning: How the Genes Influence Educational Attainment, from; National library of Medcine, <https://pmc.ncbi.nlm.nih.gov/articles/PMC6635910> ,15/07/2025, 10h30