A Comparative Empirical Study Beyond Words: Neural Machine Translation Under Scrutiny

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Abstract
The relatively recent advent of advanced neural machine translation (NMT) models has certainly revolutionized cross-lingual communication in different languages, making the machine role vitally more crucial in solving and facilitating real-life situations, ordinary as well as professional. This research paper presents an empirical comparison of two prominent NMT systems, Google Translate and Gemini (an AI chatbot), in translating English texts into Arabic. By analyzing two distinct text samples – a factual statement, a proverbial expression. This study evaluates their performance based on accuracy, fluency, and domestication and foreignization when applicable. The findings highlight the varying strengths and weaknesses of each system, offering a clearer picture in accordance with analytical observations of implications for academic and professional translation contexts.

Keywords: *Machine Translation, Neural Machine Translation, Google Translate, Gemini, Translation Quality, Cross-Lingual Analysis.*

1. Introduction

Machines, just like humans, proved to be greatly flexible in terms of learning in general, but also translating through the use of different techniques, strategies, and approaches. 'Meta' is a prefix which, when used in its adjectival form, can mean "referring to itself or to something of its own type:
It's a meta joke. It's sort of a joke about jokes." [1] (Cambridge). Meta-learning is accordingly learning (how) to learn, which would make it safely automatic to assume a conscious recognition by learners of the process they're engaged in, which is called metacognition; making it possible and easy to distinguish between learning and acquisition; the former being conscious while the latter is rather unconscious.

Machine-Aided Translation (MAT) or Computer-Assisted Translation (CAT) can serve as a springboard for translators to reduce the time and effort needed to complete the translation of a large volume of documents, and although the human factor is partly spared in the first stage, it's still mandatory to double-check the results before submitting them. In the same vein, Machine Translation (MT) can go even further by almost completely replacing human translators. It has been around for over half a century, but its performance/competence has not ceased to improve ever since, "In 1954, IBM introduced a translation solution that lessened the reliance on humans. The 701 Electronic Data Processing Machine, the company's first commercial scientific computer, ran an experimental software program to automatically translate Russian into English." [2] (Niles, n.d.).

Artificial Intelligence (AI), through chatbots, has been expanded into intelligent automatic translation via learning about translatology, just like chatbots intelligently learn (about) virtually everything else. Augmented Reality (AR) devices can also be equipped with a translator to detect,

read and translate texts on signs for instance, that is why this research paper will tackle two very important issues manifested in the extent to which professional human translators can approve of machine translation reliability, which raises the second issue that has been observed recently in AI chatbots' capability of mastering many languages concurrently, making the term 'hyperpolyglot' another characteristic that is no longer only human.

2. Machine-Aided Translation

Translation is a time-consuming task that requires constant full attentiveness, and even the most proficient translators cannot complete the translation of a lengthy Source Text (ST) as fast as the machine can, which is why this tendency of resorting to the machine aid seems to be growing by the day among freelancers, but also among translators working behind their desks in offices (or) for big companies. The reassurance comes from the fact that the Target Text (TT) must and will be proofread by human experts, which makes the trust in the machine fairly and justifiably limited. However, available results are sometimes more of restricting hurdles than fruitful outcomes, as the translator will rely on what can be easily found in an electronic dictionary, whether it is a word or an expression, and the latter is probabilistically more difficult to find since it's composed of a certain order of words that may or may not be found in the database of the machine.

From a simple test of input versus output in one of the most used online multilingual concordance, it is crystal clear that Linguee dictionary could provide, as documented below in the appendices, both denotative and connotative equivalents of words apart, however, it was also crystal clear that it could not do the same for searchable phrases, which has led to a visible lack of sought-after results in the Target Language (TL) due to the simple reason that even if the input in the source text were found in the database, the output in the target text could not be found at its level because there seems to be no room for AI in this particular process.

A safe conclusion would be that the more words juxtaposed in a certain order, the less likely to find their translation in such dictionaries, unless there is a parallel text as we may find on some official bilingual/multilingual websites such as: https://www.canada.ca/en/immigration-refugees-citizenship.html, https://www.un.org/

3. Machine Translation

Machine translation, on the other hand, is supposed to be relied on completely but not unconditionally, for the option of post-editing should always be available, and although different methods have been developed throughout the years, human translators must always remain vigilant and skeptical about the results.

4. Computer-Assisted Translation

Computer-Assisted Translation (CAT) refers to the use of software to help a human translator in the translation process. However, it remains essential to distinguish CAT from MT, such as Google Translate. While MT performs automated translation with minimal human intervention but often requiring post-editing, CAT tools are designed to improve the human translator's abilities, making their work more efficient, consistent, and accurate, but more importantly quicker and easier.

5. Translation Memory

The cornerstone of any MAT/CAT system is a translation memory which is a database that stores previously translated source and target language pairs (segments). When a translator works on a new text, the TM analyzes each new segment in its stored content, yet the results may not always be as accurate as we would want them to be;

5.1. Fuzzy Matches

If a new segment is similar but not identical to a stored segment, it's presented as a fuzzy match, indicating the percentage of similarity, in which case translators can then adapt the existing translation results to their specific needs.

5.2. Exact Matches

If a segment is identical 100%, the TM automatically inserts the previous translation, boosting speed significantly and ensuring perfect consistency.

5.3. Context Matches

In-Context Exact (ICE) are found when some TMs can identify exact matches that appear in the same surrounding context, providing even greater confidence in the reuse.

6. Terminology Management Systems (TMS)/Termbases

Termbases are specialized databases containing approved terms and their translations, often with definitions, contexts, usage notes, and even images.

7. Quality Assurance (QA) Tools

Integrated QA tools are essential for maintaining the high accuracy required in scientific and technical translation, but they also help identify potential errors and inconsistencies before delivery. These tools can check for:

7.1. Terminology Inconsistency: Mismatches with the termbase.

7.2. Numerical Discrepancies: Incorrect transfer of numbers.

7.3. Formatting Errors: Tag issues, missing spaces.

7.4. Grammar and Spelling Errors: Beyond basic spell checkers.

7.5. Completeness: Untranslated segments.

8. Alignment Tools

These tools allow translators to create TMs from existing source and target language documents that were translated without a TM. “Translation alignment involves using a translation alignment tool to convert your previously translated documents into translation units (TUs). These units are then integrated into a translation memory (TM) to be reused within a computer-assisted translation (CAT) tool. This streamlined process maximizes the efficiency of existing translation materials.” [3] (Trados, n.d.).

9. Post-Editing/Transediting

While traditional translation involved creating a target text from scratch, modern mechanisms often involve transediting which “is carried out when the translator translates the text and then adjusts the text for a specific purpose, or even first edits the source text before being translated. Meanwhile, trans-creation is carried out to translate advertisements freely. Meanwhile an adaptation is made if the "translator" creates a new advertisement that is completely different from the source advertisement.” [4] (Plyth & Craham; 2023).

9.1. Editing TM Matches

Reviewing and refining segments pulled from the Translation Memory to ensure they fit the new context and maintain flow.

9.2. Post-Editing Machine Translation (PEMT)

This is a rapidly growing area where translators refine raw MT output to meet the required quality standards. This requires a different skill set than traditional translation, focusing on error identification, stylistic correction, and ensuring natural-sounding language.

10. Rule-Based Machine Translation (RBMT)

RBMT operates in accordance with linguistic and lexicographic rules. The process involves the software analyzing the source text against a predefined set of grammatical rules and lexical entries, subsequently converting it into the target language. A key advantage of RBMT lies in its predictable output, offering precise control over both the analytical process and the translation results. However, the development of RBMT systems is time-consuming, requiring significant investment from linguistic and computational experts to establish a functional system for specific text types. RBMT suits particularly high-volume translations of specialized documents, such as comprehensive software documentation, user manuals and automotive manuals where consistency and accuracy across multiple versions are central.

11. Corpus-Based Machine Translation (CBMT)

In contrast, CBMT utilizes extensive bilingual corpora collected from source texts and their human-translated equivalents. From this data, the system constructs a translation table, which essentially functions as a probabilistic dictionary detailing the frequencies of potential translations for words or short phrases. Translations of phrases could produce less results compared to single-word translations as shown in the appendices. A crucial component of this statistical approach is a language model for the target language, designed to select combinations that produce

grammatically correct and meaningful sentences. CBMT encompasses both Statistical Machine Translation (SMT) and Example-Based Machine Translation (EBMT). The primary strength of CBMT is its reliance on these bilingual translation tables, which reduces the need for a rule-based system, hence making the system's preparation less time-consuming than RBMT.

12. Hybrid Machine Translation (HMT)

It represents an integration of RBMT and CBMT methodologies. The objective of HMT is to synthesize the strengths of both approaches while reducing their apparent weaknesses. Various combinations exist, exemplified by/in systems such as Lingstat and METIS-II.

13. Neural Machine Translation (NMT)

The most recent and continuous approach in machine translation is Neural Machine Translation (NMT). This method employs programmed models that mimic the biological structure of neurons, learning from data through deep learning algorithms. Unlike statistical machine translation, which decomposes sentences into numerous subcomponents, NMT processes and translates entire sentences holistically. Successful operation of an NMT system necessitates an extensive parallel corpus, which would automatically suggest that scarcity of training data can significantly degrade translation quality. The absence of sufficiently large parallel corpora poses a challenge for many language pairs, particularly less commonly spoken languages such as Basque or Czech, and even for more widely known combinations such as Russian-Ukrainian.

14. Automatic Translators

Automatic translators such as Google Translate, Bing Translator, Babylon, Systranet, and Prompt, are not typically/professionally/necessarily considered machine translation tools. Their main drawbacks include occasional decontextualized output and even a lack of confidentiality regarding input data, as information entered into these services may be automatically stored. Consequently, their use might be avoided by professional translators and editors due to contractual obligations concerning data security and translation accuracy.

15. AI Chatbot

This is a computer program designed to simulate human conversations through text or voice. Unlike simpler, rule-based chatbots that rely on pre-programmed scripts, AI chatbots rely heavily on advanced artificial intelligence technologies to understand, interpret, and generate human-like responses, and even though the whole process would not take more than a few seconds, it often has to go through several stages and mechanisms before and during the time of processing the input;

15.1. Natural Language Processing (NLP)

This is the core technology that enables AI chatbots to understand human language. NLP involves several techniques:

15.1.1. Natural Language Understanding (NLU)

This component allows the chatbot to interpret the meaning, intent, and context of a user's input, even if it's phrased in different ways or contains grammatical errors.

15.1.2. Natural Language Generation (NLG)

This component allows the chatbot to formulate coherent and grammatically correct responses in intelligible human language.

15.2. Machine Learning (ML)

AI chatbots are trained on vast amounts of data like customer service interactions, conversations, documents, etc. Machine learning algorithms identify patterns in this data, allowing the chatbot to learn and improve its responses over time without direct explicit programming for every possible scenario.

15.3. Large Language Models (LLMs)

Many modern AI chatbots, such as ChatGPT and Gemini, are powered by LLMs. These are very large neural networks trained on massive datasets of text and code, enabling them to generate highly sophisticated and contextually relevant responses, engage in open-ended conversations, and perform creative tasks.

16. Contrastive Analysis of Translation Outputs

16.1. Methodology

To compare the translation capabilities of Google Translate and Gemini, two distinct English text samples were created, representing different degrees of linguistic complexity and cultural nuance. The source texts were inputted into both Google Translate and Gemini, and their respective Arabic outputs were then qualitatively analyzed by a native Arabic speaker with expertise in translation. The evaluation criteria focused on:

Accuracy: How faithfully the meaning of the source text is conveyed in the target language.

Fluency: The grammatical correctness, naturalness, acceptability and readability of the target text in the Arabic output.

Domestication and Foreignization: The extent to which the translation respects cultural nuances and avoids awkward or offensive phrasing.

16.2. Text Samples

16.2.1. Sample 1 (Factual Statement)

English Source Text

"The rapid advancements in artificial intelligence have profound implications for the future of human-computer interaction."

16.2.1.2. Sample 2 (Proverbial Expression)

English Source Text (Input)

"Actions speak louder than words."

16.3. Results and Discussion

16.3.1. Analysis of Sample 1

16.3.1.1. Google Translate Output

"إن التقدم السريع في الذكاء الاصطناعي له آثار عميقة على مستقبل التفاعل بين الإنسان والحاسوب."

- **Accuracy**: High. The translation accurately conveys the original meaning, and although it has clearly ignored the pluralized form of the subject 'advancements', the choice of the equivalent in Arabic 'التقدم' does convey the meaning in its singular form.
- **Fluency**: Good. The sentence structure is grammatically correct and flows naturally in Arabic.
- **Domestication and Foreignization**: N/A (neutral statement).

16.3.1.2. Gemini Output

"التقدم السريع في الذكاء الاصطناعي له تداعيات عميقة على مستقبل التفاعل البشري الحاسوبي."

- **Accuracy**: High. The meaning is preserved.
- **Fluency**: Good. The phrasing "التفاعل البشري الحاسوبي" (HCI), however, is slightly less precise and less commonly used in technical Arabic contexts than "التفاعل بين الإنسان والحاسوب" (interaction between human and computer).
- **Domestication and Foreignization**: N/A.

• **Discussion**: For a straightforward factual statement, both systems delivered highly accurate and fluent translations. Gemini's choice of phrasing for "human-computer interaction" demonstrated a slight deviation in terms of preciseness under uncommon technical lexicon in Arabic, suggesting a potentially less nuanced understanding of domain-specific terminology.

16.3.2. Analysis of Sample 2

• **English Source Text (Input)**

"Actions speak louder than words."

16.3.2.1. Google Translate Output

"الأفعال أبلغ من الأقوال."

- **Accuracy**: Not entirely literal, but does not lack appropriate idiomatic and semantic equivalence. While grammatically correct, it directly translates the English idiom idiomatically, which carries the same idiomatic weight and naturalness in Arabic, even though 'أبلغ' literally means 'more eloquent.'
- **Fluency**: High. It's understandable and sounds very natural as a proverb in Arabic.
- **Domestication and Foreignization**: High. Arabic has well-established proverbs that convey this meaning. A literal translation could miss the cultural load.

16.3.2.2. Gemini Output

"الأفعال أبلغ من الأقوال."

- **Same observations.**

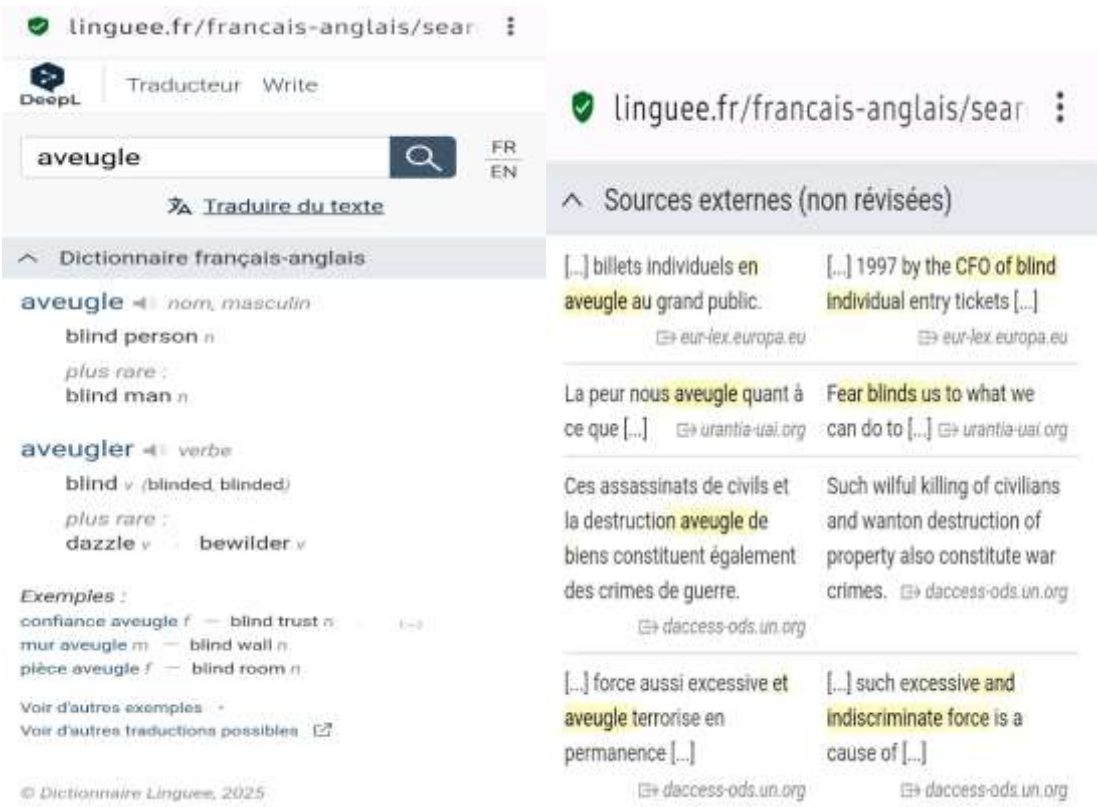
- **Discussion**: This sample clearly illustrates identical results. Both Google Translate and Gemini opted for a commonly used equivalence, and managed to capture the idiomatic essence. This example takes us back to the old dichotomy of dynamic equivalence versus formal equivalence where "the translator is under constant pressure from the conflict between form and meaning." [5] (Nida, 1964), but also opens the door to the old renewed debate as to how/if the machine can replace/outperform the human.

17. Conclusion

While NMT systems like Google Translate and Gemini have made remarkable results, particularly in handling relatively complex linguistic and cultural nuances, the necessity for post-editing by human translators remains a crucial element in many other examples. This study underscored the reduced role of the human translator, shifting from primary text generation to quality assurance and refinement. The ongoing development of AI chatbots with hyperpolyglot capabilities further emphasizes the transformative impact of machine learning on translation. As these technologies continue to advance, future research should delve deeper into domain-specific translations, the handling of highly specialized jargon, and the ethical considerations surrounding data privacy and intellectual property in machine translation workflows. Ultimately, the main goal is not to replace human translators but to empower them with increasingly sophisticated tools that enhance efficiency and expand the reach of cross-lingual communication.

Appendix


linguee.fr/francais-anglais/sear
DeepL
Traducteur Write
pair
FR
EN
Traduire du texte
Dictionnaire (français)
pair nom, masculin (pluriel: pairs m)
peer n (pluriel: peers)
Sa carrière est une inspiration pour ses pairs.
Her career is an inspiration for her peers.
pair adjectif, masculin
(paire f sg, pairs m pl, paires f pl)
even adj
Deux et quatre sont des chiffres pairs.
Two and four are even numbers.
Exemples :
hors pair — unparalleled unmatched
aller de pair v — go together v
nombre pair m — even number n
Voir d'autres exemples
Voir d'autres traductions possibles
© Dictionnaire Linguee, 2025
linguee.fr/francais-anglais/sear
Sources externes (français)
[...] que nous appelons de nos vœux, doit aller de pair avec un renforcement de la transparence, une [...]
europarl.europa.eu
[...] must go hand in hand with greater transparency, greater accountability and compliance with the [...]
europarl.europa.eu
[...] régionaux intégrés qui, d'ailleurs, peuvent aller de pair avec une aide massive de l'Union européenne dans la [...]
europarl.europa.eu
[...] add, can go hand in hand with a massive aid effort on the part of the European Union in terms of bringing the [...]
europarl.europa.eu
[...] continuité des soins va de pair avec l'amélioration [...]
chsrf.org
[...] continuity of care were associated with increases [...]
chsrf.org


linguee.fr/francais-anglais/sear
DeepL
Traducteur Write
aveugle
FR
EN
Traduire du texte
Dictionnaire français-anglais
aveugle nom, masculin
blind person n
plus rare :
blind man n
aveugler verbe
blind v (blinded, blinded)
plus rare :
dazzle v bewilder v
Exemples :
confiance aveugle f — blind trust n
mur aveugle m — blind wall n
pièce aveugle f — blind room n
Voir d'autres exemples
Voir d'autres traductions possibles
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linguee.fr/francais-anglais/sear
Sources externes (non révisées)
[...] billets individuels en aveugle au grand public.
eur-lex.europa.eu
[...] 1997 by the CFO of blind individual entry tickets [...]
eur-lex.europa.eu
La peur nous aveugle quant à ce que [...]
urantia-uai.org
Fear blinds us to what we can do to [...]
urantia-uai.org
Ces assassinats de civils et la destruction aveugle de biens constituent également des crimes de guerre.
daccess-ods.un.org
Such wilful killing of civilians and wanton destruction of property also constitute war crimes.
daccess-ods.un.org
[...] force aussi excessive et aveugle terrorise en permanence [...]
daccess-ods.un.org
[...] such excessive and indiscriminate force is a cause of [...]
daccess-ods.un.org


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DeepL
Traducteur Write
pair en double-aveugle
FR
EN
Traduire du texte
Dictionnaire français-anglais
pair m — peer n
pair adj — even adj
en double — duplicate adj
aveugle m — blind person n — blind man n
Voir d'autres exemples
Voir d'autres traductions possibles
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Sources externes (non révisées)
[...] de protocole (test en "double aveugle" contre placebo). boiron.com
[...] size and study design (double blind, placebo-controlled). boiron.com
[...] organisons des dégustations en double aveugle, dans des verres opaques, [...] biereetsante.be
[...] we hold tasting sessions - double blind, in dark glasses, without [...] biereetsante.be
[...] compactage est allé de pair avec un double saut relativement haut. geodynamik.se
[...] compaction occurred at relatively high double jump. geodynamik.se
[...] prospective, double-aveugle, placebo contrôlé, il est démontré qu'il existe une amélioration du rendement physique d'adultes en santé, supplémentés [...] uhtco.ca
In this prospective double blind placebo controlled study it is demonstrated that exists an improvement in the physical yield of healthy adults [...] uhtco.ca


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DeepL
Traducteur Write
évaluations par les pairs
FR
EN
Traduire du texte
Dictionnaire français-anglais
évaluations par les pairs
nom, pluriel, féminin
peer reviews pl
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Sources externes (non révisées)
[...] également leurs évaluations par les pairs, qui sont essentielles [...] europarl.europa.eu
[...] are also providing their peer reviews which are important [...] europarl.europa.eu
Les évaluations par les pairs se sont avérées utiles et enrichissantes [...] eur-lex.europa.eu
Peer reviews have proved to be useful and enriching exercises for [...] eur-lex.europa.eu
Ces évaluations par les pairs ont pour objet [...] eur-lex.europa.eu
The aim of these peer reviews is to determine [...] eur-lex.europa.eu

References

1. “meta-“, Cambridge Dictionary. n.d. https://dictionary.cambridge.org/dictionary/english/meta?q=meta-
2. B. Niles, “Machine-Aided Translation”, IBM, n.d. https://bit.ly/4m7OHTN
3. “Translation Alignment”, Trados, n.d. https://www.trados.com/learning/topic/translation-alignment/
4. P. S. Plyth and C. P. Craham, “Translation affects literary and cultural systems:
how to observe the features of translation?”, Journal of Applied Translation. vol. 17, no. 1, **(2023)**, p. 10.
5. E. A. Nida, “Toward a Science of Translating”, E. J. Brill, Leiden, **(1964)**, P. 2.