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Assessment of Automated Translation Services

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INTRODUCTION

Translation is necessary for the spread and sharing of information, knowledge, and ideas. Translation is more than just words and grammatical structure. As noted by language teacher and researcher Valerie Spreeman, though the individual wording may be similar, if one were to translate "my heart will go on" to "my cardiovascular muscle will continue," the original message of steadfastness will be lost. (Spreeman 2017) Above all else, true translation aims at communicating meaning from one language to another to avoid situations like the one just described. Traditionally, human linguists have taken a large role in the translation process to ensure that the translated text makes sense in context and is culturally appropriate. With the introduction of consumer-level automatic machine translation tools, it has become easy to simply type a word or phrase into a text box and choose the language for translation. Machine translation has become ubiquitous, instantly available, and accessible to anyone with an internet connection. But is it time to remove humans from the translation process? Have automatic translation tools reached a high enough level of accuracy to be relied upon to communicate meaning?

TRANSLATION TECHNOLOGY

Regardless of the language, in order to build a sentence effectively, a writer must employ semiotics, the study of signs and their meanings. Semiotics is comprised of syntax, semantics, and pragmatics. Syntax is the structure of how a sentence is built and the arrangement of the words. Semantics refers to the meanings of words and phrases and how they are understood if there are multiple meanings for one word or if the dictionary definition and the connotations of words or phrases can differ. Finally, Pragmatics refers to the goal of the sentence and whether the writer's ideas can be clearly understood by the intended audience. (Spreeman 2017) Since semiotics is essential for effective communication, it also forms a foundation for developing translation technologies as developers seek to produce tools to enable the effective and understandable translation of text.

When understanding translation technology, it is important to distinguish between machine translation technology and computer-assisted translation technology. Computer-assisted translation is essentially a human translation based process with the aid of computerized translation software. This software generally focuses on organizing text and making the translation process more time-efficient for human translators. With computer-assisted translation, experienced human translators are still a necessary component of the process. With this understanding, machine translation technology where the translation process is fully automated will be the focus of this report.

Machine translation technology can generally be categorized into three main systems: Rule-based, Statistical, and Neural. Rule-based machine translation software is built upon algorithms that analyze the source language and use rules developed by human experts to translate structures from the source language into the target language. (Allue 2016) Using a series of mathematical equations, rule-based systems review the structure of a sentence in one language and use a matching structure in another language to rebuild the sentence when fully translated. With rule-based systems, idioms, slang, and other, more abstract aspects of language cannot usually be correctly translated. (Spreeman 2017) Statistical machine translation systems also employ equations for translation; however, they apply the math differently. Statistical machine translation systems create several possible translation hypotheses and then statistically evaluate the correctness of each hypothesis until it can choose the one with the

highest probability of accuracy. (Spreeman 2017) An advantage of statistical machine translation systems is that they have a better chance of accuracy; however, they are more challenging to create a model for and require more data than a rule-based system. Neural machine translation uses networks that consist of many nodes that relate to each other and builds relationships based on bilingual texts used to train the system. These systems, modeled after how the human brain processes languages, can to some degree "learn" the languages it is translating and make connections and translations that it was not specifically taught. (Spreeman 2017) Neural machine translation technology excels at deciphering contexts and choosing the appropriate translation based upon the context; however, these technologies often have issues with more complex sentences. Considering the advantages and drawbacks of technology based upon the three main systems, "the best results with machine translation are found when two or more of these systems are used together." (Spreeman 2017)

Information Gathering

To start the information gathering process, the study team attempted to interview language and translation experts, including a faculty member from the Department of Spanish and Portuguese at Rutgers University, a representative from the Language Center at Rutgers University, and a representative from a translation services company. Each expert consistently underscored the nuances and ambiguity associated with language, emphasizing that every automated translation tool is far from perfect and cannot replace expert human translation. Even after the study team agreed with this point, in all three conversations, the experts declined to engage in a follow-up discussion about the merits of individual automated translation products. As a result, the research team decided to instead pursue a broader range of scholarly and non-scholarly texts.

While most of the authors of scholarly articles about assessing the reliability or accuracy of machine translation technology expressed similar sentiments to the experts contacted during this study, they acknowledged the limitations of automated translation technology while assessing these tools on their merits. While the systems evaluated sometimes change, nearly every article written in the past ten years regarding the evaluation of machine translation systems includes Google Translate. Google Translate is well recognized and the most used translation service throughout the world. According to Google, as of 2016, over 500 million people were translating 100 billion words each day in 103 languages using Google Translate. (Turovsky 2016) As of October 2020, the number of languages supported by Google Translate had increased to 109. The initial version of Google Translate was launched in April 2006 and was centered around statistical machine translation. Through this process, the text identified for translation is translated first into English as an intermediary step language and then into the target language, cross-referencing the phrase in question with millions of documents taken from official United Nations and European Parliament transcripts. (Sommerlad 2018) Building upon initial success with the statistical model, in 2016 Google Translate was updated with a neural translation model. Using deep learning methods, the service is able to translate and compare whole sentences at a time from a broader range of linguistic sources. Deep learning is an aspect of artificial intelligence seeking to replicate human learning, constricting an artificial neural network that can be trained through exposure to existing examples. This update was aimed at achieving greater accuracy by giving the full context rather than just sentence clauses in isolation. "By comparing Japanese-to-English translations with Korean-to-English, the service is able to deduce and map out the relationship between Japanese and Korean and make translations back and forth between those two languages accordingly, a great leap forward in computers'

understanding of semantics, a process still confounded by metaphorical expressions and quirky idioms." (Sommerlad 2018) By continually processing these calculations, Google Translate can spot recurring patterns between words in different languages, continuously improving its chance for accuracy.

While Google is one of the most popular translation systems and one of the most noted in academic studies, is it the best? Several studies of online translation systems have been conducted using humans to review the results. Some of the more relevant findings are summarized below:

- In a 2009 study, common phrases translated from German and Spanish into English with four online translation services were evaluated. The findings showed that Google Translate was the most accurate, followed by Systran and X10 in a tie for second, and then Applied Language. Further study of Google Translate involved students choosing among multiple choices and writing their own understanding of translations showed that even in cases where the grammar becomes garbled, the meaning could often be ascertained. (Aiken, et al., 2009)
- A 2010 study evaluated and ranked online machine translators, which are available on the Internet and free of charge to the general public, for the quality of their target text translations from English to Spanish and then from Spanish to English. Five types of targeted sentences were evaluated: idiom, formal, lexical ambiguity, phrasal verb, and grammar. Though it was not top-ranked in every category, Google Translate had the highest overall score, followed by Babylon, Reverso, Bing, Babelfish, Systran, PROMT, WorldLingo, InterTran, and Webtrance. (Hampshire and Salvia 2010)
- In a 2017 study, Google Translate, Bing, and Babylon were compared for translating Urdu to Arabic sentences by using three performance evaluation metrics, BiLingual Evaluation Understudy (BLEU), Metric for Evaluation of Translation with Explicit Ordering (METEOR), and National Institute of Standard and Technology (NIST). Each metric uses different calculations and algorithms to measure accuracy. As a rule, a machine translation that is closer to the reference translation is considered to be more accurate; this is the central idea behind the machine translation evaluation methods. The results show that Google translator, on average, outperforms Bing and Babylon by 15.74% and 28.55% in BLEU technique, 13.74% and 3.28% in METEOR technique, 20.83% and 3.91% in NIST technique, respectively. (Ayesha et al. 2017)
- Another 2017 study analyzed Anusaaraka, Bing, Babelfish, Mantra, and Google Translate based on the translation of English texts into Hindi. The study concluded that of the translation systems studied, Google Translate has the highest accuracy percentage with an overall efficiency score of 82.66%. Bing and Babelfish have around the same accuracy (~77%), and Anusaraaka and Mantra were found to have the least accuracy, making them less reliable for translation. (Kharb et al. 2017)
- The most recent study on the subject was published in July 2020. This study provided a comprehensive evaluation of Google Translate, Bing Translator, Systran, PROMT, Babylon, WorldLingo, Yandex, and Reverso. The study evaluated each system using Chinese, English, Hindi, Spanish, Arabic, Malay, and Russian in all combinations except Chinese as the target. Results showed that Google Translate was more accurate overall as compared to the other seven options in the study. The study noted that Google Translate is more accurate when the source language and target language are similar languages or dialects. A translation from English to Spanish will generate better quality translation than translation from German to Hindi. It was

also noted that Google Translate supports far more languages than competitors do. (Vanjani and Aiken 2020)

In addition to academic studies, evaluations of automated translation systems by users were also sought. In various blog articles and technology review sites, the user experience for a variety of systems was rated. Many of these resources were related to companies operating individual translation systems or systems that build off another's technology, such as Google. None of these resources have been included due to the potential for bias. Following a review of available resources, the most relevant findings are summarized below:

- G2 (formerly G2 Crowd) is a peer-to-peer review site headquartered in Chicago, Illinois. G2 prides itself on showing unbiased reviews on user satisfaction in their ratings and reports. They do not allow paid placements in any of their ratings, rankings, or reports. With 148 reviews, Google Translate was the most rated and highest rated service in the G2 Machine Translation Software comparison. Google Translate was ranked with a score of 4.5 out of 5, followed by Microsoft Translator with a score of 4.1, and Yandex Translate with a score of 4.0.
- Lifehacker is a weblog about life hacks and software with posts covering a wide range of topics, including Microsoft Windows, Mac, Linux programs, iOS and Android, as well as general tips and tricks about improving life. Users were asked to nominate and rank the five best language translation tools. Receiving nearly half of the total votes, Google Translate was the clear winner, followed by Bing, Linguee, and WordLens.

While not regularly mentioned in scholarly texts, DeepL Translator received more mention in user-based rankings and discussions of automated translation services. Launched in August 2017, DeepL is a free, neural machine translation service founded by a former Google employee. DeepL stands for deep learning, the same area of artificial intelligence aimed at replicating human learning, which was at the core of the Google Translate update in 2016. The team behind DeepL feels that what distinguishes their system from Google is their very high-quality training material and running regular blind tests to make sure the program keeps its high standards. (Smolentceva 2018) DeepL claims to be "the world's best translation machine," backing this claim with the results of their own August 2017 blind test published on their website comparing DeepL's results with those of their rivals: Google and Microsoft (Smolentceva 2018). In this test, the rival systems were given 100 sentences to translate from English into German, French and Spanish and from German, French, and Spanish into English. Following machine translation, professional translators reviewed the produced text and rated the quality of each translation. DeepL was chosen three times more often than Google because its translation sounded more natural (Smolentceva 2018). Unfortunately, there is not enough information about how these evaluations have been conducted that would allow an impartial party to substantiate them at this time.

While no peer-reviewed journal articles referencing scientific studies could be found declaring DeepL superior to Google Translate, some individuals running their own less-scientific experiments have declared DeepL to be superior in certain situations:

- In a blog article on the website for the University of Strasbourg's Online Master's Degree in Technical Communication and Localization, Alexandra Deparvu discusses the results of her own informal experiment to test the capabilities of DeepL using a non-fictional text from the European Personnel Selection Office (EPSO) Comparing the original French source text and the two machine-translated target texts, Deparvu experienced better results from DeepL, noting that Google Translate seemed to go for the more literal translation, while DeepL tried to include synonyms in order to not lose certain nuances, and this difference eventually resulted in a more natural translation. Deparvu admits that this was by no means a comprehensive experiment and no definite claims can be made as to the relative proficiency of both systems; however, within the scope of her experiment DeepL outperformed Google Translate (Deparvu 2018).
- The Globalization and Localization Association (GALA) is a global, non-profit trade association for the language industry. In an undated white paper attributed to GALA, three authors claim to confirm that DeepL is better than Google Translate. The study employs quantitative analysis regarding the percentage of correct translations per defined linguistic category. Although the percentages are nearly identical, DeepL performs better than Google in all categories except one. The authors note that Google performs particularly well, namely with above 90% of correct translations, on one category: nonverbal agreement. DeepL performs particularly well in three categories: verb valency, non-verbal agreement, and composition. Verb valency is the category with the most significant gap between the two systems' performance as DeepL achieves 34.1 percentage points more than Google. Their overall conclusion is that "in a comparison of the Google Translate and DeepL systems for German-English where we could confirm the observation that DeepL performs a little better than Google on our test set" (Macketanz et al.).
- Text United, a cloud-based translation platform based out of Vienna, Austria, has a ranking of free machine translation engines on their website. While they tout the accuracy of DeepL, the lack of scope and scale of the DeepL platform is also noted. Google Translate is ranked number one due to its usability and the fact that it operates with more languages and language combinations than any other alternative. TUFT, their own Machine Translation service, is based on Google Translate and integrates with their other services and technology (Plotnik 2020).

While DeepL is an innovative service that has its admirers, there is not enough available scientifically based data to prove that it is more accurate than Google Translate. Where Google Translate truly outshines DeepL is its ability to translate over 100 languages compared to DeepL's 11 languages. Google Translate is often preferred due to its simplicity, speed, and features, such as its ability to allow users to import documents for translation directly. While DeepL is a powerful tool, Google seems to offer the most comprehensive, flexible, and easy to use machine translation service.

WHEN IS THE USE OF MACHINE TRANSLATION APPROPRIATE?

In nearly all scholarly articles related to assessing machine translation technology's reliability or accuracy, a statement is made regarding the differences between "word-for-word" translation and "sense-for-sense" translation. This becomes a problem as words and phrases in a language have both history and meaning often not found in other languages. Machines rely on the data they are given and are more likely to mistranslate as they have no way to understand that there is a layer of historical, cultural context over the words (Spreeman 2017). Studies have found that machine translations, including Google Translate, generally fall into this trap by delivering a word-for-word, but not a sense-for-sense translation pattern.

As a result, even though Google Translate is a powerful tool, a number of mistakes can still be found, especially for words that have multiple meanings and functions (Vidhayassi et al. 2015). It has also been demonstrated in numerous studies that although Google Translate provides translations among a large number of languages, the accuracies of these translations vary greatly. Translations between European languages have generally been found to have the best results, while those involving Asian languages are more likely to be poor. The best results occur when the source language and target language are similar languages or dialects (Aiken & Balan 2011). In one study, sentences were translated into French, German, Japanese, and Spanish. Native speakers of the languages volunteered to evaluate the translated output using two sets of scales: intelligibility and accuracy. It was found that the results for accuracy and intelligibility were similar, with the German output receiving the worst evaluations for both metrics. The Japanese output for both metrics received the second-worst evaluations. The Spanish output had the highest evaluation for intelligibility and received the joint highest evaluation, along with French, for accuracy. Overall it was found that the majority of the French and Spanish output was of reasonably high quality but still required some post-editing. The German and Japanese output was of lower quality and needed more substantial correcting before publication (Tobin 2015).

While still noting the prevalence of errors, studies dating back as far as 2011 have also noted that the vast majority of language combinations offered via Google Translate seem to provide sufficient accuracy for reading comprehension (Aiken & Balan 2011). As noted in the Tobin study's conclusion in 2015, in the majority of the sentences chosen, it would seem that the Spanish and French output is understandable but not perfect (Tobin 2015). To determine whether the output is sufficient, the translated text's potential function needs to be taken into account. Output of such quality may be useful for general information purposes and can be used to generate new thoughts or other points of view. Machine translation is fast, cost-effective, and relatively accurate, and therefore excels when used in informal settings where accuracy is not as important so long as one gets the gist of the information (Spreeman 2017). However, manual translation by human translators works better when deeper and more extensive knowledge on the subject of translation is required, especially when translating text with specific contents, terms, conditions, or legal information (Vidhayasai et al. 2015). In a 2013 study to determine whether translation software could be used to help Legal Services Agencies deliver legal information, the authors concluded that the technology was not yet accurate enough to reliably communicate legal information; a very sensitive topic. While the tools did not yet meet the assessed need, the authors were confident that machine translation software tools will continue to improve and bring the quality of pure machine translation closer to the quality of human-dependent tools, but ultimately predicting that it will be at least a decade before a human can perform a merely trivial review of automated translations (Hogue & Hineline 2013). In a recent study involving undergraduate students using Google Translate, one of the data collection methods involved a questionnaire to gather data about the accuracy in content, acceptability, and readability. The target readers' responses regarding the translated text were positive. Ratings were measured along a scale of one to three, with one signaling inaccuracy, unacceptability, and unreadability, while three indicates accuracy, acceptability, and high readability level. Data analysis results show that: the average score for content accuracy is 1.97, the average score for acceptability is 1.93, and the average score for readability is 2.07 (Simanjuntak 2019). Based upon this analysis, the author concluded that the level of message accuracy, acceptability, and readability of the translated abstract text by Google Translate obtained an average score of 1.97 or closer to the score of 2, which means that the quality of this translation is close to good quality even though the translated text message is rendered less accurate into the target language (Simanjuntak 2019). Like Hogue and Hineline, Simanjuntak is looking to the future, noting that with continued improvements and program updates, it is expected that Google Translate will become one of the most reliable translation machines in the future (Simanjuntak 2019). While Google Translate is one of the most popular and accurate translation machines available, it still has

weaknesses in adjusting inaccurate words that may cause misunderstanding by the user without significant human intervention and correction.

Conclusion and Recommendations

As the designated Metropolitan Planning Organization for Atlantic, Cape May, Cumberland, and Salem Counties, The South Jersey Transportation Planning Organization (SJTPO) is tasked with providing access to federal transportation funds in the region in a manner that is consistent with federal laws and guidance. Transparency through public access to participation in the planning process is an essential part of this task. Public participation is solicited without regard to race, color, national origin, age, sex, religion, disability, or family status. To maintain an effective and meaningful public involvement process, SJTPO has also sought to overcome language barriers that may prohibit people who are Limited in English Proficiency (also known as persons with LEP) from understanding and participating in the public planning processes.

Accurate translation of critical documents is the cornerstone of effective outreach and meaningful involvement. Traditionally, human linguists have taken a large role in the translation process to ensure that the translated text makes sense in context. While an excellent choice for ensuring accuracy, understanding, and cultural appropriateness, expert human translation comes with financial costs and time constraints that can make continual use of these services unsustainable. With the introduction of automatic translation tools, it has become possible to remove that costly human element from the equation by simply typing a word or phrase into a text, choosing the language for translation, and instantly receiving results. While automatic translation tools have become inexpensive and easy to use, there are two important questions; are they good enough, and can they be used effectively?

This assessment has sought to shed some light regarding both questions. Within the last decade, advances in automated translation technology have been astounding. Following the review of both scholarly and more user-based tests and reviews of available technology, this assessment has concluded that Google seems to offer the most comprehensive, flexible, and easy to use machine translation service at this time. While Google has come a long way, the many nuances and ambiguity of languages restrict their translation tool to be less than perfect. Google Translate performs exceptionally well and approaches its highest quality translating between English and Spanish. Unfortunately, Google Translate is weakest in translation between English and Asian languages, some of the more difficult and thus costly languages to translate. While Google does best translating between English and Spanish, at this time there is still too much room for error when accurate understanding is imperative. Based on these findings, at this time, it would be inappropriate to recommend the use of Google Translate for the translation of vital SJTPO documents used to communicate specific, targeted information.

Google Translate could be most useful to SJTPO in less formal situations when relied upon not for specific translation of vital information but for facilitating conversation via the public participation and engagement process. Google Translate could be used to translate brief general information documents, meeting fliers or support materials, and translating public comments or interacting with the public at live events. As SJTPO continues to grow and expand its partner network, Google Translate could also be used more widely if verified by a native speaker on staff or affiliated with a partner organization serving targeted outreach communities. While providing a complete translation would be a time-consuming and

challenging task, a partner may be more willing to review and make minor corrections to a smaller document that has already been translated via Google Translate to help ensure appropriateness. If SJTPO chooses to use Google Translate, it should be made clear via the website or in the document itself that Machine Translation was used and is for information purposes only.

Professional translation services remain the best choice for accuracy, understanding, and cultural appropriateness, especially when translating to languages other than Spanish. To limit the financial costs and time constraints inherent in the professional translation process, it is recommended that SJTPO develop a relationship with and make strategic use of a full-service translation services agency. SJTPO should seek to develop a list of frequently used information and phrases that can be professionally translated. Information including SJTPO descriptive language and facts, program descriptions, and basic outreach information can be used in multiple documents, formats, and settings moving forward. Relying on accurate key information made available through professional translation and using Google Translate to fill-in the missing parts would allow SJTPO to develop new documents or update existing documents with a higher level of confidence that the message will be received effectively. Similarly, minor updates to professionally translated vital documents could also be made quickly using Google Translate with a higher level of confidence that the document's overall meaning has not been changed. If used strategically, a hybrid approach of relying on professionally translated source materials while making adjustments and updates via Google Translate could help SJTPO expand communication throughout the region while limiting costs.

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