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# The Effect of L2 Proficiency on Post-editing Machine Translated Texts

**Eun Seon Chung**

*Hankuk University of Foreign Studies, South Korea*

The present study examines how proficiency in the second language (L2) affects language learners' ability to post-edit texts that are machine-translated from the learners' native language (L1) to L2. More specifically, the study investigates how L2 proficiency level affects the degree to which Korean learners of English can discern the accuracy of L1-to-L2 machine-translated (MT) text and whether it affects the level of errors (word, phrase, clause, sentence) that are corrected in the post-editing process. Fifty-nine Korean university students' proficiency was measured using a cloze test and a writing test. They were then given a source text (Korean) and a machine-translated text (English) and were asked to detect and correct as many errors as they can. The overall results of the study showed that L2 proficiency does have a significant effect on how language learners post-edit machine-translated output. With increasing proficiency, the number of corrections increased especially above the word-level, and significant group differences could be found in post-editing patterns of the MT text. The findings have important pedagogical implications for integrating MT activities in L2 classrooms with learners of different proficiency levels.

Keywords: machine-translation, post-editing, L2 proficiency, L2 writing, error-levels

## Introduction

With recent development in digital technology and the widespread use of the internet, language learners are increasingly using and relying on web-based or mobile app machine translation (MT), such as Google Translate, which offers free translation service in over 100 languages. It has switched from the previous statistical machine translation system to the neural machine translation system which learns from a vast amount of online data samples and translates whole sentences at a time. The technological advances and increasing accuracy of MT are transforming the landscape of second/foreign language classrooms as it has become a widely used tool that students rely on for language learning. However, research on this topic is scarce, and teachers and practitioners often express mixed opinions about the use of online technology in the classroom as they try to come to terms with benefits and threats of MT. Given the widespread availability of online resources in the classroom, it seems almost inevitable that students will use MT, and we need to determine how to incorporate this tool in a way that enhances students' language learning experience.

Previous research in MT use has centered on analyzing structures that are especially vulnerable to translation errors and mistranslations (Dhakar, Sinha, & Pandey, 2013; Ghasemi & Hashemian, 2016), analyzing written texts by second language (L2) learners who used MT (Lee, 2019; Groves & Mundt, 2015), surveying learners' attitudes and use of MT (Im, 2017; Larson-Guenette, 2013; White & Heidrich, 2013), and searching for pedagogical applications and implementing translation tools in the context of

teaching (Correa, 2014; Enkin & Mejías-Bikandi, 2016; Garcia & Pena, 2011). While much has been discussed about the educational implications of translation in L2 writing, it is not yet clear how exactly the learners use and integrate MT in their writing and whether individual learner differences such as proficiency level affect how learners use this online tool. Given the gap in the literature and the importance of this topic, the present study examines how L2 proficiency affects EFL learners' ability to post-edit machine-translated texts.

# Literature Review

## Limitations and Benefits of MT

Despite the substantial progress made in translation technology over the years, it is still challenging to produce error-free texts using MT, and frequent errors have been reported in grammar (Groves & Mundt, 2015; Niño 2009), register (formal vs. informal) and cultural references (Correa, 2014; Niño 2009), colloquial language (Luton, 2003), pragmatic usage that convey subtle meaning (Ducar & Shocket, 2018), polysemic words (Abraham, 2009) and proverbs and idioms (Correa, 2014; Kim, 2018; Luton, 2003). In translations between Korean and English more specifically, Chang (2018) reported that MT shows general weaknesses in tag-questions, echo-questions, gerunds, NP-movements, relative pronouns, the passive voice, and polysemic words. Kim (2018) also pointed out that the optionality of Korean case-markers and the phenomenon of pro-drop where subjects may be omitted in Korean often result in syntactic discrepancies and mistranslations. Furthermore, Jo, Park, and Jun (2013) examined English-to-Korean translations in Google Translate and found that five types of transitivity alternation—causative, conative, middle, preposition drop, understood object—could not be translated accurately due to lexical semantic differences between English and Korean. As such, MT is far from perfect in preserving the meaning of the original text, and limitations can be found on all morphological, lexical, and syntactic levels.

Despite such limitations of MT, this freely available technology is widely used and is found to offer numerous benefits in teaching and learning of a foreign/second language. Previous studies have revealed that MT use in language learning can enhance fluency (Garcia & Pena, 2011), accuracy (Tsai, 2019), paraphrasing skills (Niño, 2009), and lexical choice (Chen et al., 2015). Tsai (2019) evaluated Chinese students' written texts that were first written in the native language (Chinese), then drafted in English, and lastly translated into English using Google Translate. When the English texts were compared and analyzed using online computational assessments, MT English texts were evaluated to be higher in quality in grammar, spelling, and word choice leading the author to conclude that MT can indeed provide effective support in EFL writing. In fact, educational activities such as analyzing mistranslations, pre-editing, and post-editing were found to help develop meta-linguistic awareness by directing students' attention to the differences and similarities between their native language and their L2 (Abraham, 2009; Correa, 2014; Enkin & Mejías-Bikandi, 2016; Niño, 2009; Somers, 2003). O'Neill (2012, 2016) found that such activities and training in the use of MT enable learners to write more accurately and receive higher subscores on L2 writing tasks (comprehensibility, spelling, content, and grammar) than those who did not. In addition to linguistic advantages, using MT as a supplementary tool has also been found to help lower student anxiety and increase confidence in language learning (Bahri & Mahadi, 2016; Jin, 2013; Niño, 2009). As such, most studies seem to agree that with adequate guidance, using MT can lead to positive learning outcomes by helping students to analyze and explore the target language.

## MT Post-editing and L2 Proficiency

Among the educational activities that focus on MT as a tool for L2 learning, post-editing, which refers to the process of correcting and editing machine-translated text, has been frequently implemented. Early

works of MT post-editing centered on training language students in the translation profession who were mainly upper intermediate and advanced learners (French, 1991; La Torre, 1999). These works found that using MT can complement language learning and can provide valuable vocational experience by developing crucial skills such as critical thinking and linguistic awareness. Niño (2008) also examined advanced language learners' performance of translation and MT post-editing and found that the experimental group who post-edited the MT text had a significantly smaller number of lexical, grammatical, and spelling errors than the control group who translated the same text without the aid of MT. In Lee's (2019) study, intermediate to high-intermediate students translated their L1 writing into L2 without using MT and then revised their L2 translations by post-editing the translation provided by MT. Lee found that using the MT improved students' writing by decreasing lexical and grammatical errors and also helped students to develop positive writing strategies.

Notwithstanding such benefits of MT post-editing, it has also been pointed out that students need more training and education in the use of MT in the editing process. Lee (2017, 2018) found that undergraduate students majoring in translation often focused on revising individual lexical items and micro-level errors instead of bigger units (phrases/ clauses/ sentences) and often made revisions that did not fully take the context into account. Moreover, students were often at a loss when asked to revise awkward phrases or sentences that were laden with technical vocabulary. As such, despite the clear benefits of MT use in language learning, it seems that using MT may have a variable effect that could rather present difficulties for the learner depending on the specific task and the target group. In fact, it is not yet clear whether the use of MT can also be beneficial for language learners with low L2 proficiency as has been found for intermediate to advanced learners. Most argue that advanced learners can use MT much more effectively than beginners (Larson-Guenette, 2013; Niño, 2009). Kol, Schcolinik, and Spector-Cohen (2018) conducted awareness and correction tasks of MT output and found that advanced students identified and corrected a higher number of mistakes than intermediate students. In a similar vein, Kaye (2009) argued that using MT is an effective learning method for advanced learners, but not for beginners.

Garcia and Pena (2011), one of the few studies that have investigated MT post-editing by beginner and low intermediate language learners, found that using MT unquestionably leads to a higher number of words, but other linguistic advantages are marginal and not so obvious. The authors concede that despite helping beginners to communicate at length with less strain, it is not altogether clear whether learning takes place when using MT. Considering the vague assessments of writing tasks and the small sample size of this study, the benefits of MT use by beginner and low intermediate language learners must be further investigated. Other studies that mention the benefits of MT use for lower level language learners observe that using MT gives learners the opportunity to understand and produce texts that may be too advanced for them (Niño, 2009). Lee (2019) also observes that lower proficiency learners are more likely to focus on the benefits rather than the downsides of MT than higher proficiency learners particularly with regard to fixing word choice and lexico-grammatical errors. However, most of these observations do not systematically compare MT use by learners of different proficiency levels, and there is a dearth of research on the effect of L2 proficiency on the learners' ability to post-edit machine-translated text. While we know that advanced learners are more capable of detecting and correcting a higher number of errors (Kol et al., 2018), we do not yet know what kind of translation errors are detected and corrected by learners of varying proficiency levels. Previous research makes it clear that when writing in the L2, advanced learners are more likely to produce longer texts (Crossley & McNamara, 2012; Jung et al., 2019), display greater lexical variety (Grant & Ginther, 2000; Jarvis et al., 2003), and generate syntactically complex and accurate texts with a higher number of nominalization/subordination (Grant & Ginther, 2000; Liu & Li, 2016) and error-free T-units (Hwang, 2012). Whether such linguistic features can also be observed for MT post-editing remains to be seen. Knowledge of how learners analyze and revise MT output can inform how practitioners can use this online tool in the classroom and what specific guidelines to give to learners with different levels of proficiency. Therefore, the present study examines the effect of L2 proficiency on learners' ability to post-edit MT output. More specifically, the study investigates how L2 proficiency affects the degree to which Korean learners of English can discern the

accuracy of the MT output and whether proficiency affects the level of errors (word, phrase, clause, sentence) that are corrected in the post-editing process. The results of this study are expected to shed light on the relationship between L2 proficiency and MT use and provide implications on ways to integrate MT in language learning and teaching.

# Method

## Participants

Fifty-nine Korean EFL students (29 females and 30 males; ages 19-22) from different majors and departments at a university in Seoul, Korea participated in the study. Their English proficiency was measured using a cloze test and a writing test. The cloze test consisted of 20 multiple-choice questions that tested participants' knowledge of vocabulary and grammar and could be completed in 10 minutes. The writing test asked the participants to compose a paragraph in English on the topic of "Characteristics of Successful Students". Students were given 30 minutes to complete the writing test and were not allowed to use the dictionary or other resources for both proficiency tests. Students' compositions were assessed on the CEFR[1] (Common European Framework of Reference) scale with level A1 being the lowest and C2, highest. The levels were then converted into numeric scores ranging from 30 (A1) to 100 (C2), and these scores were recalculated on a 20-point scale in order to match the scale of the cloze test. Simple bivariate correlation analysis via Pearson coefficient showed that the cloze test scores were positively correlated with writing scores ($r = .573$) at a statistically significant level ($p < .01$). The final proficiency score (out of 40 points) was calculated by combining the cloze test score with the numeric writing score (Range 7-31, Average: 21.19).

## Materials and Procedure

In the main experimental task, an excerpt of a movie review written in Korean (taken from a Korean university newspaper[2]) was machine-translated into English using Google Translate and Papago—another widely used MT in Korea provided by Naver Corporation. The researcher then took and combined all the mistranslations and errors from the two translated versions (Google and Papago) and created another version of the same text (henceforth, combined MT text) that had a higher number of errors than Google and Papago translations. This was done in order to maximize the number of errors in the MT text and to give students ample opportunity to find and correct as many errors as they can. Samples of each version of the text is presented in (1) below.

(1) Samples of MT texts

a. Source text
고등학교 철학 교사인 '나탈리'는 떠나가는 것들에 대해 고민한다. 남편'하인츠'는 다른 사람이 생겼다며 갑작스레 이별을 통보하고 나이든 어머니는 불안증으로 인해 자살시도 후 요양원에 들어간다. 오랫동안 같이 일하던 출판사는 철학 교재 개편 작업에서 그녀를 제외한다. 이렇게 자신의 곁을 점점 떠나가는 것들에 대해 나탈리는 어떤 자세를 취해야 할까.

Natalie, a high school philosophy teacher, is concerned about all she is losing. Her husband, Heinz, suddenly leaves her saying he is seeing someone else, and her elderly mother who is suffering from anxiety disorder goes into a nursing home after attempting suicide. The publishing company where

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[1] CEFR scales for students' compositions were assessed using a computational tool—a certified website called *Write and Improve* created by Cambridge English.
[2] The source text in Korean can be found at http://press.uos.ac.kr/news/articleView.html?idxno=10578

she has been working for a long time excludes her in the process of rewriting the philosophy textbook. How should Natalie react to such increasing loss in her life? [translated by the researcher]

b. Google

Natalie, a high school philosophy teacher, is concerned about what goes away. Her husband "Heinz" suddenly notifies him that another person has been born, and his elderly mother enters the nursing home after attempting suicide due to anxiety. The publisher, who has been working for a long time, excludes her from the philosophy textbook reorganization. What kind of attitude should Natalie take with regard to things that are leaving her side.

c. Papago

*Natalie, a high school philosophy teacher, is thinking about going away. Hines, the husband of Hainz, suddenly announced his breakup, saying, "There is someone else," and his old mother goes to a nursing home after committing suicide due to anxiety. The long-time publishing company excludes her from the restructure of philosophy. What position should Natalie take about leaving her side more and more?*

d. Combined MT Text (Google + Papago)

*Natalie, a high school philosophy teacher, is thinking about going away. Hines, the husband of Hainz, suddenly notifies him that another person has been born, and his old mother goes to a nursing home after committing suicide due to anxiety. The publisher, who has been working for a long time, excludes her from the restructure of philosophy. What position should Natalie take about leaving her side more and more?*

The final version of the MT text (1d: combined MT text) mostly suffered from awkward or inaccurate phrasing, lexical errors, omission of content words, inconsistent use of pronouns, and wrong references. There were hardly any grammatical or punctuation errors that needed to be corrected. The participants were instructed to read and compare the combined MT text (English) and the source text (Korean) and were asked to detect errors and post-edit the combined MT text for 30 minutes. This post-editing task was done in a paper-and-pencil format, and the participants were asked to mark all errors they can find and correct them. No particular instruction was given about either the format or method of correction in order to observe the participants' uninhibited post-editing patterns and behavior that may vary depending on the proficiency level.

## Data Analysis

Students' post-edited text was analyzed by the researcher by counting the number of corrected errors and recording the unit of post-editing that were categorized into words, phrases, clauses, and sentences. To distinguish clauses from sentences, corrections that changed the whole sentence or changed the sentence structure was included in the sentence-level, whereas changing a subject and its predicate in a part of a sentence was included in the clause-level. When determining the level of corrected errors, the level of the revised output, not the level of the detected error, was counted. That is, if a wrong word was corrected to a phrase, the correction was included in the phrase-level, and if a phrase was changed into a word, it was counted in the word-level. Therefore, the level of the error that was detected did not necessarily match the level of correction. The detected errors were considered 'corrected' if the revision improved the error in terms of naturalness and/or grammaticality but were not counted in the number of corrections if the revision did not improve the error (e.g., substituting a wrong word with an equally inappropriate word), made the error even worse or more awkward, or when the error was left uncorrected. Table 1 below presents samples of each level of corrected errors.

TABLE 1
*Samples of Corrected Errors*

| Level | | Detected Errors | Corrected Errors |
|---|---|---|---|
| Word | Ø > word | the restructure of philosophy. | the restructure of philosophy *textbook.* |
| | word > word | *Hainz/him* | *Natalie/her* |
| | phrase > word | *more and more* | *gradually* |
| Phrase | Ø > phrase | They don't decide what to do before they die, | They don't decide what to do before they die *like the movie <Bucket List>* |
| | word > phrase | *he* | *the main character* |
| | phrase > phrase | feel *your worries* | feel *the director's consideration* |
| Clause | phrase > clause | *committing suicide* | *she tried to commit suicide* |
| | clause > clause | that *another person has been born* | that *he cheated on her with another person* |
| Sentence | sentence > sentence | *What position should Natalie take about leaving her side more and more?* | *What could Natalie do in this desperate situation?* |

In light of previous findings that report robust effects of L2 proficiency on L2 reading and writing performances, it can be predicted that more proficient learners will detect and correct a higher number of errors and make revisions that are more accurate and extensive than those of low proficiency learners.

# Results

The overall results of the study show that L2 proficiency has a significant effect on how language learners post-edit MT output. Learners with high proficiency scores had a significantly higher number of corrections than lower proficiency learners, and student's post-editing patterns with regards to error levels also varied depending on proficiency.[3] Proficiency had a significant effect for sentences ($F(1, 57) = 19.393$. $p < .001$) and phrases ($F(1, 57) = 24.039$, $p < .001$), and a marginally significant effect on the number of corrected errors for clauses ($F(1, 57) = 3.636$, $p = .062$). In order to examine the effect of proficiency in greater detail, the students were divided into three proficiency groups based on their final proficiency scores: Students with scores less than 25th percentile of all the scores were included in the low proficiency group and students with scores greater than 75th percentile in the high proficiency group. The remaining others were included in the intermediate group. There was a total of 16 high, 22 intermediate, and 21 low proficiency learners.

All three groups made the highest number of corrections at the word-level. For intermediate and low proficiency learners, more than half of the corrections (60~65%) were words, followed by phrases (19~24%), clauses (14%), and sentences (2%). High proficiency learners, on the other hand, had a similar number of corrections for phrases and words (37% and 38% respectively), and a similar number of sentences and clauses (13% and 12% respectively). The overall results indicated that with increasing proficiency, the number of corrections also increased especially above the word-level. When the mean number of corrected errors were compared across groups in each category, the intermediate proficiency group had the highest mean for Words and Clauses, the high proficiency group had the highest mean for Phrases and Sentences, and the low proficiency group had the lowest mean in all four categories. These results are presented in Table 2.

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[3] Since the MT text hardly contained any errors in grammar, punctuation, or mechanics, the number of corrections in these categories were negligible and were not included in the analysis.

TABLE 2
*Descriptive Statistics of Corrected Errors*

|  | Error Level | Percentage (%) | Mean | Std. Deviation |
|---|---|---|---|---|
| High | Word | 37.82 | 3.69 | 3.34 |
|  | Phrase | 36.54 | 3.56 | 1.83 |
|  | Clause | 12.18 | 1.19 | 0.83 |
|  | Sentence | 13.46 | 1.31 | 1.54 |
| Int | Word | 60.10 | 5.68 | 2.82 |
|  | Phrase | 24.04 | 2.27 | 1.08 |
|  | Clause | 13.94 | 1.32 | 0.72 |
|  | Sentence | 1.92 | 0.18 | 0.40 |
| Low | Word | 65.22 | 3.57 | 2.54 |
|  | Phrase | 19.13 | 1.05 | 1.20 |
|  | Clause | 13.91 | 0.76 | 0.63 |
|  | Sentence | 1.74 | 0.1 | 0.30 |

The results were analyzed using repeated one-way ANOVAs, and significant group differences were found in all four levels as shown in Table 3. Post-hoc comparisons using Tukey HSD test showed that the means for word-level and clause-level corrections by intermediate learners were significantly higher than those of low proficiency learners (Words: $p = .05$, Clauses: $p = .037$). All three groups were significantly different in the mean for phrase-level corrections (High vs. Int: $p = .015$, High vs. Low: $p < .001$, Int vs. Low: $p = .012$) with high proficiency learners having the highest mean and low proficiency the lowest. Moreover, high proficiency learners had a significantly higher mean for sentence-level corrections compared to the other groups (High vs. Int: $p < .001$, High vs. Low: $p < .001$). These results are presented in Table 3 and Figure 1 below.

TABLE 3
*Main Effect of Proficiency Group in Four Error Levels*

|  | F | p | Post-hoc (Tukey HSD) |
|---|---|---|---|
| Word | 3.546 | .035* | Low < Int* |
| Phrase | 15.646 | < .001*** | Low < Int*, Low < High***, Int < High* |
| Clause | 3.432 | .039* | Low < Int* |
| Sentence | 11.142 | < .001*** | Low < High***, Int < High*** |

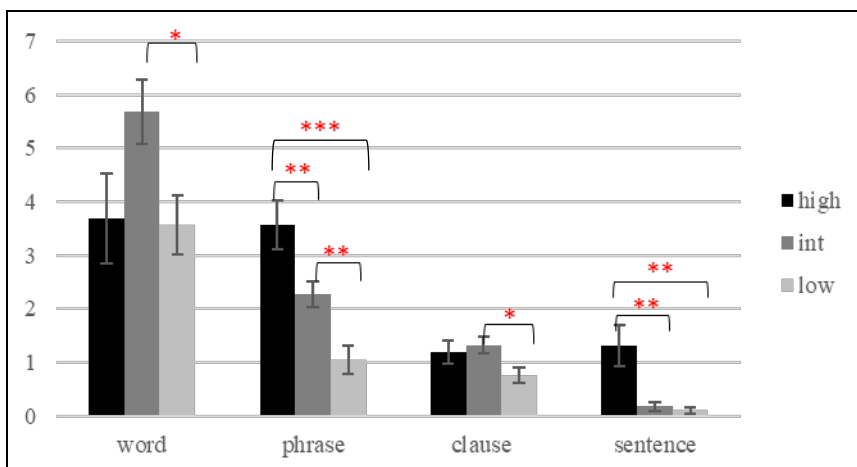*Note.* *$p < .05$, **$p < .01$, ***$p < .001$



*Figure 1*. Group differences in mean number of error corrections.

When the number of corrections was compared to the number of detected errors (i.e., errors that were marked but not counted as corrected or were left unedited), high proficiency learners had the highest

percentage of corrections (92%) followed by intermediate (90%), and then low (77%). When the format of the post-edited revisions were examined, 62% (10 out of 16) of the learners in the high proficiency group as compared to 18% of intermediate (4 out of 22) and 9% of low (2 out of 21) proficiency learner groups chose to rewrite or retranslate the whole text on the blank space underneath the MT text or on a separate piece of paper instead of making revisions directly on the MT text or between the lines of the text. By rewriting the whole text, the revisions were not constrained by the overall form and sentence structure of the MT output, and learners who revised in this format made frequent attempts to revise complete sentences. On the other hand, most intermediate and low proficiency learners were reluctant to revise whole sentences and focused on smaller parts of sentences while keeping the sentence structure of the MT output intact. Low proficiency learners commonly corrected word-level errors in pronouns ("he" → "she"), possessives ("his" → "her"; "your" → "their/audience's"), names ("Hainz" → "Natalie"), relative pronouns/adverbs ("who" → "where"), and omitted words ("textbook"). Only when the MT output was obviously far-fetched (e.g., "another person *has been born*" for "*falling in love with* another person") did they attempt to correct phrase- or clause-level errors. Another notable difference between proficiency groups was the degree of sensitivity to subtle lexical differences between Korean and English. High proficiency learners' corrections revealed that they were aware of subtle meaning differences between synonyms whose equivalent words in Korean may have different nuances and connotations (e.g., *worries* vs. *concern*, *restructure* vs. *revision*). These revisions suggested that advanced learners did not merely settle for acceptable translations but were keen on finding the exact word in the L2 that can convey the same meaning as the source text. While such refined vocabulary knowledge was also exhibited by a few intermediate learners, subtle meaning differences in lexical choice and wording were consistently overlooked and disregarded by low proficiency learners.

## Discussion

The present study investigated the effect of proficiency on language learners' post-editing skills of machine-translated text. More specifically, the study examined how Korean learners of English of varying proficiency levels corrected errors of different language levels (word, phrase, clause, sentence) in their revisions of MT output. The results of the present study indicate that students' post-editing patterns with regards to error levels are significantly affected by proficiency. All three proficiency groups made word-level corrections most frequently similar to findings of Lee (2019) in which word-level corrections were twice as frequent as phrase or clause/sentence levels, but the groups showed notable differences in their willingness and ability to revise bigger error units.

One of the most salient differences was that high proficiency learners were more willing to and capable of reconstructing complete sentences and coming up with their original translations of the source text. More than half of these learners retranslated the whole text on a blank space which allowed them to freely explore lexical and syntactic alternatives. In contrast, most intermediate and low proficiency learners preferred to cross out errors and make direct changes to the MT output, which compelled them to work within the structure imposed by the MT text. The revision format seems to demonstrate the ways in which learners approach the task of MT post-editing which in turn affects the subsequent analysis and corrections/revisions. The high proficiency group had the highest mean for phrases and whole sentences, but not clauses, contra predictions. The relatively low number of clause-level revisions can be explained by the fact that advanced learners' sentence-level revisions would have included clauses within those sentences. Also, it is worth pointing out that previous studies have also found advanced writers to communicate complex ideas by increasing phrasal density rather than increasing clause-level syntactic complexity (Ortega, 2003; Yoon, 2017). Both intermediate and low proficiency groups had a strong tendency to focus on lexical errors, but intermediate learners made more frequent attempts to revise phrase- and clause-level errors and had the highest mean number of error corrections for words and clauses among the three groups. Low proficiency learners were considerably different from the other

groups in their strong tendency to simply adopt the MT translation without significant changes. While they took up pronounced errors in references, pronouns, names, and omissions, they were unable to detect or correct inaccurate or awkward parts of the text that were translated too literally. That is, subtle meaning differences between Korean and English that required sophisticated lexical knowledge were often overlooked by low proficiency learners. In addition, they failed to correct more than 20% of the detected errors as compared to less than 10% for the other two groups and had the lowest mean number of corrections in all four error-levels.

These findings suggest that the ways in which MT output is used and analyzed is determined by learners' proficiency as learners become more critical of and succeed in detecting and correcting bigger error units with increasing proficiency. This is not surprising considering previous research findings on the effect of proficiency in L2 writing in which advanced learners produced longer, more complex, and more accurate sentences with diverse vocabulary (Crossley & McNamara, 2012; Grant & Ginther, 2000; Hwang, 2012; Jarvis et al., 2003; Jung et al., 2019; Shin & Kim, 2014). While advanced learners did not necessarily produce longer revisions overall, they were willing to revise larger units and write more in their own words. Similarly, the advanced writers' revised sentences may not have been any more complex than sentences in the MT output, but they were able to change and reconstruct whole sentences instead of merely focusing on micro-level corrections as the low proficiency learners did. Lexical advantage was the most obvious, as advanced learners exhibited refined vocabulary knowledge that recognized the subtle meaning differences between Korean and English words. These findings provide support for the moderating effects of L2 proficiency on the linguistic analysis of translated output and subsequent post-editing skills. Given the fact that analysis and revision of MT output requires both L1 and L2 competence and is also related to both reading and writing skills, these findings are consistent with the findings of Pae (2018) in which a strong interdependent relationship was found between L2 proficiency and L2 writing as well as between L1 and L2 writing skills. Pae (2018) suggests that L2 learners with high levels of L2 proficiency can attain high levels of performance in L2 reading and writing in tasks of varying cognitive complexity levels. Although the present study did not measure or examine the learners' L1 skills, the evident effects of L2 proficiency in a task which involves both L1 and L2 skills also seem to provide support for the Linguistic Threshold Hypothesis (Alderson, 1984; Cummins, 1979), which identifies L2 proficiency as a significant factor that determines the strength of the relationship between L1 and L2 skills.

In addition, the present results add to the previous literature that supports MT use in the L2 classroom. Post-editing MT output seems to be an appropriate activity that can measure learners' underlying linguistic knowledge and help learners become linguistically aware of the differences and similarities between L1 and L2. However, the present findings suggest that the degree to which the learners can learn from MT post-editing heavily depends on their L2 proficiency. Low proficiency learners who cannot discern the accuracy of MT texts for the most part tend to simply accept and adopt the MT output without critical analysis, and therefore, MT use and MT-related activities with low proficiency learners must be carefully conducted with sufficient guidelines. For low proficiency learners, activities should center on finding and revising low-level errors with a special focus on lexical choice. High-intermediate and advanced learners who can critically evaluate the MT output, on the other hand, can be given more challenging tasks and be asked to restructure whole clauses or sentences that are mistranslated. To put in other words, MT post-editing activities must be structurally planned to scaffold the learners in areas that need the most attention. Since benefits of MT use for low proficiency learners are different from those of advanced learners, practitioners must be attentive to the different needs of learners of varying proficiency levels and plan MT activities accordingly. In addition, practitioners must provide specific guidelines for general MT use, as MT is frequently used outside the classroom when the learners are on their own.

This current study is not without limitations as it is a preliminary study that can be extended and refined in many ways. While the present study finds significant proficiency effects in the learners' post-editing patterns of MT output, other variables such as the type of text (genre), type of task (online vs. offline), error types, post-editing format, text length, translation direction, and L1 competence must also

be considered in order to fully understand the extent to which MT post-editing can be beneficial for language learners. In addition to post-editing, further research must examine how learners of different proficiency levels use and incorporate MT in L2 writing by using methods such as screencasts and stimulated recalls that can analyze not only the final product but the process of MT use. Much remains to be explored to determine how to incorporate this tool in second/foreign language classrooms, and further research must help practitioners and students to make informed decisions when using this widespread online technology.

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## The Author

*Eun Seon Chung* is a research professor at the Language Research Institute of Hankuk University of Foreign Studies in South Korea. Her research interests include second language acquisition and bilingualism, and she is currently interested in the effect of online machine translation on the processing of L2 texts and the process of L2 writing.

Language Research Institute
Hankuk University of Foreign Studies
Dongdaemun-gu, Yimun-ro 107
Seoul, South Korea, 02450
Tel: +82 2173-2543
E-mail: prolingesc@gmail.com

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