

## Summary of The Korean Project with TBTA

A Korean lexicon and grammar were developed sufficient to generate multiple biblical books and community development articles. Then two sets of experiments were performed to determine the quality of the generated texts. In the first set of experiments, eighteen experienced mother-tongue translators spent 30 minutes editing drafts generated by TBTA, and they spent another 30 minutes manually translating texts from English into Korean. Then the ratios of the quantity of text they edited to the quantity of text they translated were calculated. The results indicate that using the drafts generated by TBTA approximately quadrupled their productivity. In the second set of experiments, 102 adults and 90 sixth grade children compared passages from the edited TBTA drafts with the same passages from a professionally translated and published Korean Bible for junior high students. The results of those experiments indicate that the edited TBTA drafts are essentially of the same quality as the professionally translated and published Korean Bible.

### *1. Introduction*

A Korean lexicon and grammar were developed sufficient to generate the following passages: Luke 1-10, Ruth, Esther, Daniel, Nahum, Kande's Story, a short story about preventing the spread of Avian Influenza, and another short story about preventing eye infections. Initially each verse required two to three hours of work, but by the end of this experiment, we could easily work through an entire chapter in less than half an hour. The graph in Figure 1 below shows that the number of new grammatical rules required for each chapter of text rapidly decreased.

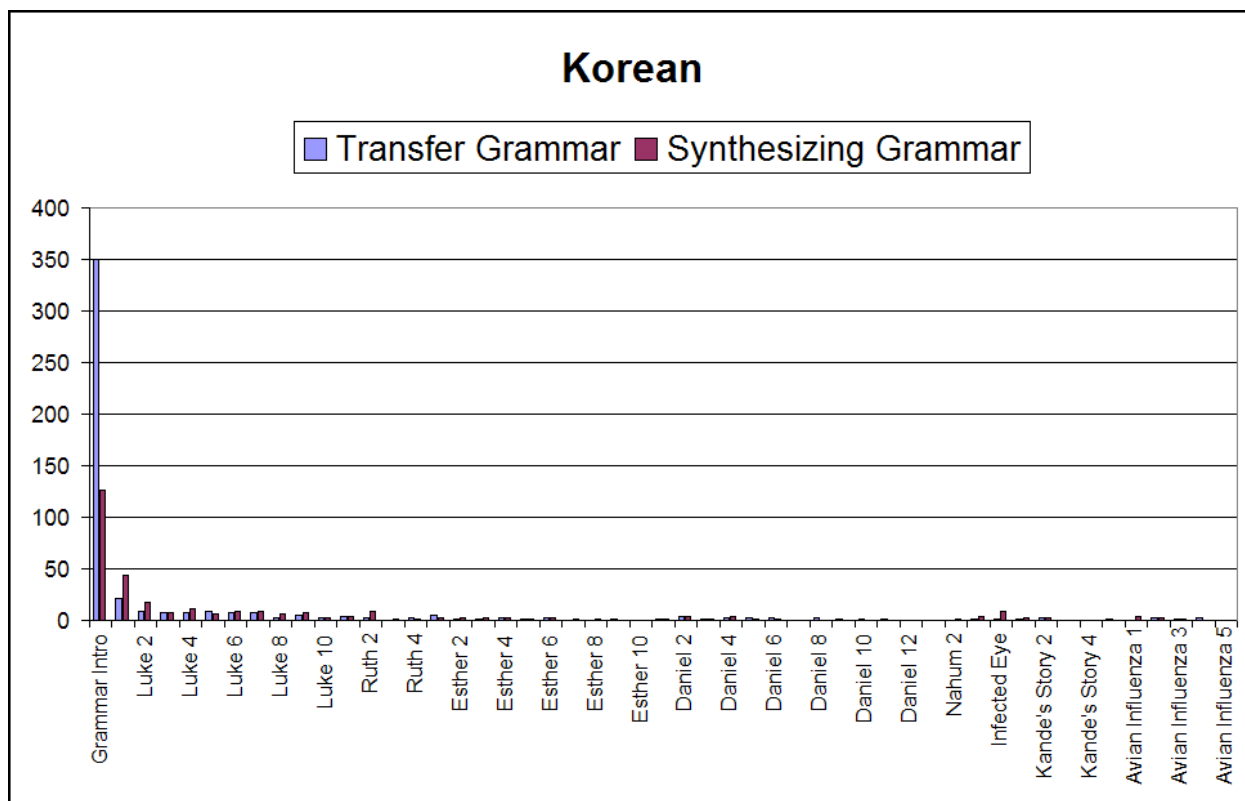


Figure 1. Graph Showing the Number of New Rules Required for each Chapter of Text

## 2) Experiments to Determine Increased Productivity

After generating drafts of the passages listed above, productivity experiments were performed with 18 experienced Korean translators. Sixteen of the participants were students at Southwestern Seminary in Fort Worth, Texas, one participant (#7 in Table 1) was an SIL member who has completed a New Testament translation in Papua New Guinea, and the final participant (#18 in Table 1) was a professional certified translator in Dallas, Texas. The first 17 translators worked with biblical texts, and the final translator worked with the text about preventing the spread of Avian Influenza. Each translator spent 30 minutes translating English into Korean, and another 30 minutes editing a Korean draft generated by TBTA. Then each participant's ratio of the number of words edited to the number of words translated was calculated. The details of this experiment are listed in Table 1 below. The results of these experiments indicate that using the drafts generated by TBTA more than quadrupled the productivity of these 18 experienced mother-tongue translators.

Table 1. Ratios of Edited Words to Translated Words

	Step 4	Step 5	Ratio
Participant #1	Translated Ruth 1:1 to 1:20	Edited Ruth 1:21 to 4:22	1827/470 = 3.9
Participant #2	Edited Ruth 1:1 to 2:23	Translated Ruth 3:1 to 4:6	1222/675 = 1.8
Participant #3	Translated Esther 1:1 to 1:20B	Edited Esther 1:20C to 5:14	2065/583 = 3.5
Participant #4	Edited Esther 1:1 to 5:14	Translated Esther 6:1 to 7:3A	2684/361 = 7.4
Participant #5	Translated Esther 6:1 to 7:3	Edited Esther 7:4 to 10:3 (18:50 minutes)	2432/428 = 5.7

Participant #6	Edited Esther 6:1 to 9:21	Translated Esther 9:22 to 10:3 (26:40 minutes)	1626/455 = 3.6
Participant #7	Edited Esther 1:1 to 2:22A	Translated Esther 2:23 to 3:15	1282/456 = 2.8
Participant #8	Translated Luke 2:1 to 2:16	Edited Luke 2:17 to 4:13	1842/319 = 5.8
Participant #9	Edited Luke 2:1 to 3:6	Translated Luke 3:7 to 3:32	1180/559 = 2.1
Participant #10	Edited Luke 4:1 to 5:20	Translated Luke 5:21 to 5:39	1468/444 = 3.3
Participant #11	Translated Luke 4:1 to 4:24A	Edited Luke 4:24B to 6:17	1794/424 = 4.2
Participant #12	Translated Luke 1:1 to 19B	Edited Luke 1:20 to 2:18	1422/412 = 3.5
Participant #13	Edited Luke 1:1 to 2:26	Translated Luke 2:27 to 2:41	1995/290 = 6.9
Participant #14	Translated Luke 7:1 to 7:21	Edited Luke 7:22 to 9:14	2400/461 = 5.2
Participant #15	Edited Luke 7:1 to 8:8	Translated Luke 8:9 to 8:27	1440/460 = 3.1
Participant #16	Translated Daniel 1:1 to 21A	Edited Daniel 1:22 to 4:23	2811/535 = 5.3
Participant #17	Edited Daniel 1:1 to 4:23	Translated Daniel 4:24 to 5:7	3379/640 = 5.3
Participant #18	Edited Avian Influenza 1:1 to 3:11 (25 minutes)	Translated Avian Influenza 3:13 to 4:4C (25 minutes)	1166/136 = 8.6 <sup>1</sup>
		Average Ratio	4.6

Participant #7 listed in Table 1 above spent approximately thirteen years translating the entire New Testament into a language spoken in Papua New Guinea. Therefore he has the most experience working as a translator. The changes that he made to the computer generated draft of Esther 1:1 to 2:22A are summarized below:

- 1) Three times he deleted a clause initial conjunction (2:8, 11, 16).
- 2) Five times he changed 'man' to 'person' (1:14 twice, 15, 16, 21).
- 3) Once he changed a noun to a pronoun (2:20).
- 4) Once he changed a name to a title (1:5).
- 5) Once he deleted a nominal (1:11).
- 6) Twice he changed a sentence initial conjunction to a different conjunction (1:6, 2:4).
- 7) Five times he moved a word to a different location in the same sentence (1:8, 11, 2:11, 14, 22).
- 8) Twice he broke a long sentence into two sentences (1:1, 5).
- 9) Once he combined two sentences into a single sentence (1:13).
- 10) Five times he added a particle for emphasis (1:1, 5, 17, 20, 21).
- 11) Five times he changed the topic marker 은/는 to 이/가 (1:15, 2:3, 4, 7, 19)
- 12) Once he changed a future tense morpheme to a present tense morpheme (2:4).
- 13) Once he added a word for clarity (2:5)
- 14) Eleven times he changed a generic word to a more specific word (1:3, 4, 7 'a lot of wine' to 'enough wine', 8, 10 'be happy' to 'be satisfied', 13 'talk' to 'discuss', 14 'talk' to 'seek advice', 19, 2:3, 17 'declare' to 'proclaim', 18 'declare' to 'proclaim').

The changes made by this translator indicate that the computer generated draft was clearly understandable and grammatically correct. The majority of his changes were the type mentioned in (14) – changing a generic word to a more specific word. This is to be expected because the semantic

<sup>1</sup> Participant #18 is the professional certified translator that was described earlier. His ratio is particularly high because he typed rather slowly. One criterion for participating in this experiment was that the person must be able to type Korean reasonably well, "reasonably well" being defined as using all his fingers while typing rather than just his index fingers, and he does not need to search for the characters. Participant #18 satisfied this criterion, but he typed slowly, so his ratio is rather high. Without his ratio, the average ratio becomes 4.3.

representations contain semantically simple, generic words because they are more likely to have good lexical equivalents in other languages.

### 3. Experiments Comparing the Quality of the Edited TBTA Drafts with a Published Korean Bible

After the productivity experiments were completed, questionnaires were developed to ascertain the quality of the edited TBTA drafts. Since TBTA has been designed to generate texts at approximately a sixth grade reading level, TBTA's edited drafts were compared with the same passages from 쉬운 성경 [swi un seong gyeong] 'Easy Bible'. The Korean Easy Bible was professionally translated and published in 2001, and is intended for students who read at a junior high level. This translation has become very popular in Korea with annual sales ranging from 100,000 to 200,000. Questionnaires were prepared and given to 102 adults at two Korean churches in the Dallas - Fort Worth area. Each questionnaire included an edited text from TBTA, and the same passage from the Korean Easy Bible. The participants in this experiment weren't told where either of the texts came from or how they had been produced. The questionnaires asked the adults to read the two texts and then indicate which text is better<sup>2</sup> for sixth grade students who are unfamiliar with the passage. Six questionnaires were prepared for each of the seventeen biblical texts described in Table 1. The results of these evaluations are shown below in Table 2. In the final column, the number after 'TBTA' indicates the number of adults who chose the edited TBTA text as being better for sixth grade students, the number after 'Easy Bible' indicates the number of adults who chose the Easy Bible text as being better for sixth grade students, and the number after 'Equal' indicates the number of adults who said that the two texts are equally appropriate for sixth grade students.

Table 2. Adult Evaluations of the Korean Texts

	Ratio	Evaluations
Participant #1	1827/470 =3.9	TBTA: 3 Easy Bible: 3 Equal: 0
Participant #2	1222/675 =1.8	TBTA: 3 Easy Bible: 2 Equal: 1
Participant #3	2065/583 =3.5	TBTA: 1 Easy Bible: 4 Equal: 1
Participant #4	2684/361 =7.4	TBTA: 4 Easy Bible: 2 Equal: 0
Participant #5	2432/428 =5.7	TBTA: 2 Easy Bible: 2 Equal: 2
Participant #6	1626/455 =3.6	TBTA: 1 Easy Bible: 2 Equal: 3
Participant #7	1282/456 =2.8	TBTA: 2 Easy Bible: 4 Equal: 0
Participant #8	1842/319 =5.8	TBTA: 2 Easy Bible: 3 Equal: 1

<sup>2</sup> The term "better" is intentionally very generic. We didn't want to ask the evaluators which text was more natural, had better information flow, or was easier to read, etc. Instead we let the evaluators choose whichever text they thought was better for any reason.

Participant #9	1180/559 =2.1	TBTA: 4 Easy Bible: 1 Equal: 1
Participant #10	1468/444 =3.3	TBTA: 2 Easy Bible: 3 Equal: 1
Participant #11	1794/424 =4.2	TBTA: 1 Easy Bible: 1 Equal: 4
Participant #12	1422/412 =3.5	TBTA: 4 Easy Bible: 2 Equal: 0
Participant #13	1995/290 =6.9	TBTA: 3 Easy Bible: 1 Equal: 2
Participant #14	2400/461 =5.2	TBTA: 5 Easy Bible: 1 Equal: 0
Participant #15	1440/460 =3.1	TBTA: 2 Easy Bible: 3 Equal: 1
Participant #16	2811/535 =5.3	TBTA: 2 Easy Bible: 3 Equal: 1
Participant #17	3379/640 =5.3	TBTA: 2 Easy Bible: 4 Equal: 0
	Total Evaluations	TBTA: 43 Easy Bible: 41 Equal: 18

Another set of evaluations was performed at a middle school in DeaGu, South Korea. New questionnaires were prepared, and 90 sixth grade children were asked to compare the edited TBTA texts with the same passages from the Korean Easy Bible. These questionnaires asked the students to indicate which text they considered better. The results of these evaluations are shown below in Table 3. The texts for Participants #5 and #6 were not evaluated by the students because those texts aren't appropriate for children when taken out of context.

Table 3. Sixth Graders' Evaluations of the Korean Texts

	Ratio	Evaluations
Participant #1	1827/470 =3.9	TBTA: 5 Easy Bible: 1 Equal: 0
Participant #2	1222/675 =1.8	TBTA: 2 Easy Bible: 3 Equal: 1
Participant #3	2065/583 =3.5	TBTA: 3 Easy Bible: 2 Equal: 1
Participant #4	2684/361 =7.4	TBTA: 0 Easy Bible: 3 Equal: 3
Participant #5	2432/428 =5.7	not evaluated
Participant #6	1626/455 =3.6	not evaluated
Participant #7	1282/456 =2.8	TBTA: 3 Easy Bible: 2 Equal: 1

Participant #8	1842/319 =5.8	TBTA: 3 Easy Bible: 2 Equal: 1
Participant #9	1180/559 =2.1	TBTA: 4 Easy Bible: 2 Equal: 0
Participant #10	1468/444 =3.3	TBTA: 5 Easy Bible: 1 Equal: 0
Participant #11	1794/424 =4.2	TBTA: 2 Easy Bible: 3 Equal: 1
Participant #12	1422/412 =3.5	TBTA: 4 Easy Bible: 1 Equal: 1
Participant #13	1995/290 =6.9	TBTA: 2 Easy Bible: 3 Equal: 1
Participant #14	2400/461 =5.2	TBTA: 4 Easy Bible: 2 Equal: 0
Participant #15	1440/460 =3.1	TBTA: 3 Easy Bible: 1 Equal: 2
Participant #16	2811/535 =5.3	TBTA: 3 Easy Bible: 2 Equal: 1
Participant #17	3379/640 =5.3	TBTA: 2 Easy Bible: 2 Equal: 2
	Total Evaluations	TBTA: 45 Easy Bible: 30 Equal: 15

These evaluation experiments indicate that both the adults and the children consider the edited TBTA texts to be of a quality that is directly comparable with a professionally translated and published Korean Bible.

#### 4. Conclusions

These experiments indicate that the Korean drafts generated by TBTA are of sufficient quality that they quadruple the productivity of experienced mother-tongue translators. These experiments also indicate that the edited TBTA drafts are of a quality that is directly comparable to that of a professionally translated and published Korean Bible.

#### Appendix A: Statistical Analysis of the Experimental Results

For the evaluations performed by the adults, the number of evaluations for each translator's text was too small to perform individual  $\chi^2$  tests, so a  $\chi^2$  test was performed using the evaluation totals. Using 43, 41, and 18,  $\chi^2(2) = 11.35$ ,  $p = .0034$ . A  $p$  value less than .05 indicates that there is skewing among these three factors. An examination of the data reveals that the reason for this skewing is because the number of 'equal' evaluations is significantly lower than the number of evaluations for the other two options. Therefore a binomial distribution was performed between the TBTA evaluations and the Easy Bible evaluations. The two tail  $p$  binomial cumulative distribution probability is .91. Since this

value is much higher than .05 which is the standard cutoff value, the difference between the TBTA and Easy Bible evaluations is insignificant. Since the difference between the TBTA and Easy Bible evaluations values is insignificant, the difference is almost certainly due to chance and is therefore not a reliable effect due to the method of testing or the difference in translation procedures. Therefore the two texts are essentially of equal quality according to the adult evaluations.

Regarding the evaluations performed by the sixth grade students, again the number of evaluations done for each translator's text was too small to perform individual  $\chi^2$  tests, so a  $\chi^2$  test was performed using the evaluation totals. Using 45, 30, and 15,  $\chi^2(2) = 15.00$ ,  $p = .0006$ . A  $p$  value less than .05 indicates that there is skewing among these three numbers. Examining the data reveals that there are two reasons for this skewing: 1) the number of students who said that the two texts are equal is significantly lower than the number of students who said that one text was better than the other, and 2) the number of students who said that the edited TBTA drafts are better is significantly higher than the number of students who said that the Easy Bible texts are better or equal to TBTA's edited drafts. Because there is skewing, a binomial distribution was performed between the TBTA and Easy Bible evaluations. The two tail  $p$  binomial cumulative distribution probability is .1053. This indicates that there is only about a 10% probability that these two numbers are reliably the same. In other words, there is a 90% probability that the students genuinely prefer TBTA's edited drafts over the 쉬운 성경 [swi un seong gyeong] texts. At this time it cannot be stated with statistical certainty that the students prefer the edited TBTA drafts, but with a larger number of respondents, a significant preference for TBTA's edited drafts might emerge.