Dealing with Cognitive Saturation in the English to Thai Simultaneous Interpreting of Quantity Numbers

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Abstract

Simultaneous interpreting is a task requiring high degrees of concentration and use of effort. It has been postulated that the three efforts involved in simultaneous interpreting are listening and analysis, use of short term memory, and speech production. The interpreter must manage these three efforts in a way that the simultaneous use of the efforts does not exceed his cognitive saturation level, after which his attempts to produce a good interpretation will fail. Additionally, it has been suggested that message density is a possible problem trigger in simultaneous interpreting while another probable cause for failure may be the absence of immediate lexical equivalents in the source and target languages. In the English to Thai simultaneous interpreting context, quantity numbers(sums) are known to be a problem trigger because they are dense in meaning and because certain magnitude numbers cannot be interpreted by mere replacement of a word in the source language with its pair in the target language, but require an additional analytical step. This paper will provide a detailed analysis of the above issues, suggest the use a technique/tool as a possible solution, and discuss the initial findings of a research on the use of mixed method note-taking among beginner level interpreting students. Research findings showed improvement in the subjects' ability to simultaneously interpret sums from English to Thai after

employing the mixed method note-taking for the interpreting of quantity numbers.

Keyword: Effort Model, cognitive saturation, simultaneous interpretation, numbers, message density

Introduction

Interpreting is a form of translation in which a first and final rendition in another language is produced on the basis of a one-time presentation of an utterance in a source language (Pöchhacker, 2016). Interpreting is a useful way to convey understanding since a speaker's meaning is best expressed in his or her native tongue but is best understood in the languages of the listeners (Nolan, 2012). At present, there are two basic types of interpreting: consecutive, where the interpreter gives his interpretation after the speaker has finished, and simultaneous, where the interpreter conveys a message into another language at virtually the same moment in time as it is expressed in the first language (Seleskovitch, 1978). In consecutive interpreting, the interpreter takes notes to assist his memory and to guide him in providing the rendition of the message. Note-taking is a legitimate activity in any type of consecutive interpreting and does not reflect negatively on the interpreter's ability. On the contrary, it is an indication of the interpreter's interest in providing the best service for the clients (Gentile et al, 1996). In simultaneous interpreting, the interpreter is compelled by time constraint to produce his rendition in a matter of seconds, yet in some cases note taking may prove to be beneficial.

Since interpreting is an instantaneous activity where the output must be produced within split seconds from the utterance of the source message in simultaneous interpreting or produced within mere minutes from its expression in the source language in consecutive interpreting, the act requires a very high degree of concentration and a number of situations are known to trigger problems in the process. Examples of such triggers include the speaker's speed of delivery, his accent, or specific content such as enumerations, names and numbers (Gile, 2009). Unlike other coherent text, numbers have very little linkage to other parts of the utterance. The structure of a

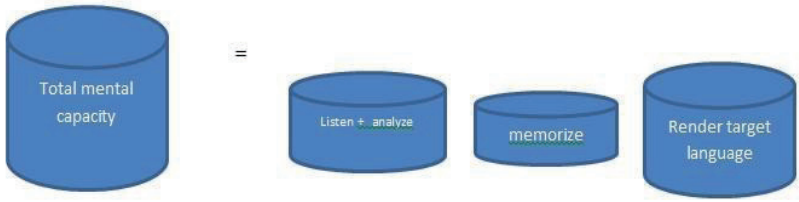
coherent text allows, or even obliges the interpreter to formulate hypotheses about the sequel of the text, but when a numeral appears within the speech, the interpreter is compelled to devote all of his attention to the incoming number and modify his strategies accordingly (Moser-Mercer, 1985). This modification may involve the interpreter assigning unequal portions of concentration to the different "efforts" simultaneously at work in a certain time span.

The Effort Model for Simultaneous Interpretation and the Tightrope Hypothesis

Interpreting requires mental energy that is available in limited supply and when the effort required is more than the effort available, the interpreter's performance deteriorates (Gile, 2009). When interpreting, the interpreter directs his efforts to listening to and analyzing the incoming speech, memorizing the content of what was said, and producing the target language rendition (Mazza, 2001). Since mental energy is available in limited supply, the interpreter needs to appropriately manage his utilization of the three efforts. Allocating more effort to one function means taking away available mental energy from the other functions; for example, if the interpreter allocates more mental energy to the listening and analyzing function, there will be less mental energy left available for the memorizing and producing functions. When the speaker has a heavy accent or when he speaks at a very high speed, the interpreter is required to delegate more effort to the listening and analyzing function, resulting in less mental energy being available for the memorizing and producing efforts. In this situation, the interpreter may fail in his task as he may have been able to understand the source speech because he had allocated enough mental energy to listening and analyzing, but might neither have been able to remember the content of the

speech nor have been able to formulate the target language rendition because there had not been enough mental energy left for memorizing and producing. The following figure illustrates how the three efforts work in such situations.

Figure 1: The Three Efforts Required for Language Interpreting



In order for a speech to be successfully interpreted, the total mental energy required for the three efforts must not exceed the total available capacity at any given time, but most of the time, interpreters work close to mental saturation, when the mental energy required for the efforts is almost equal to the total capacity. This state can be explained by using the analogy of a tightrope (Gile, 2009) that snaps when too much pressure is applied just as interpretation fails if the total mental requirement exceeds the total mental capacity.

The efforts employed in simultaneous interpreting (SI) are: listening to the source message (L), producing the rendition (P), memorizing content (M) and co-ordination of the previous three methods (C) hence SI = L + P + M + C (Gile, 2009).

Numbers as Problem Triggers in Language Interpreting

Unlike other content types in the source speech, numbers are unique because they are low in redundancy (Gile, 1999), low in predictability (Braun & Clarici, 1996), and high in informative content (Alessandrini, 1990). When interpreting quantity numbers, if the interpreter allocates more of his mental resources to the listening-analysis effort, he will have less available resources left for the other functions that must be performed simultaneously. According to Gile's (2009) Effort Model, in simultaneous interpreting, while the interpreter listens to incoming message (L), analyzes it to understand its meaning and memorizes content to be rendered soon afterwards (M), he is also producing a rendition of the previous message (P) and coordinating the previous three efforts (C) to function together smoothly. Throughout this process, the interpreter needs to manage the use of his mental energy well, distributing appropriate levels of energy to where it is required and make sure that he does not run out of mental resources. If the available mental energy is 100 units and the interpreter allocates 40% to listening and analysis (L), 30% to production (P), and 30% to using short term memory (M), he will have used up all his mental energy and have none left for the coordination (C) function hence he will not be able to coordinate well the previous three efforts, which may lead to failure in this circumstance. Likewise, if the interpreter allocates 40% to listening and analysis (L), 30% to production (P), and 30% to coordination (C), he may have no mental energy left for short term memory (M) and the interpretation attempt may fail, as well. Therefore, a key factor to the success of interpretation in this phase is the appropriate allocation of mental energy among the four efforts.

When quantity numbers are present in the source speech, more mental energy than usual is required to process the meaning of the quantities and to remember them. However, the caveat is if too much mental energy is spent on this effort, less mental energy will be left available for the other efforts. Studies have been conducted regarding the effects of numbers on English to Italian simultaneous interpretation quality and it was found that accuracy in speech segments with numbers was lower than in those

Without numbers (Mazza, 2001). It was also found that the use of ready-made number charts in conjunction with the note-taking of numbers helped to produce better outcomes in English to Thai simultaneous interpretation (Tepintrapirak, 2016). However, to date, there has been no study regarding the effects of quantity numbers on accuracy in English to Thai simultaneous interpretation for beginner level interpreting students hence no proposed solutions were made on how to deal with quantity numbers, leaving students to grapple with whatever resources available to them.

The English to Thai Quantity Number System and the Application of Gile's Effort Model

Gile (2009) posits that mental energy is required for interpreting. Since mental energy is available in limited supply and allocating mental energy to one effort results in reduced availability for other efforts, a tool was devised to assist the interpreting student in his management of the efforts. Quantity numbers are very dense in meaning and most of the time, simple word pairing is not enough to successfully interpret quantity numbers between the English and Thai language pair.

In the Thai language system, the words used in referring to quantity magnitudes consist of: *nuai* (หน่วย-one to nine) *sip* (สิบ-ten) *roi* (ร้อย-hundred) *pun* (พัน-thousand) *muen* (หมื่น-ten thousand) *saen* (แสน-hundred thousand), and *lan* (ล้าน-million). After million, a multiplier is placed in front of the number word to show the quantity magnitude. The quantity magnitudes which come after *lan* (ล้าน-million) are: *sip lan* (สิบล้าน-ten million) *roi lan* (ร้อยล้าน-hundred million) *pun lan* (พันล้าน-billion) *muen lan* (หมื่นล้าน-ten billion), and *lan lan* (ล้านล้าน-trillion). In this regard, the words *sip* (สิบ-ten), *roi* (ร้อย-hundred), *pun* (พัน-thousand), *muen* (หมื่น-ten thousand), *saen* (แสน-hundred thousand), and *lan* (ล้าน-million) are used to show the magnitude of a sum and are also used as multipliers.

The English language system for quantity formation is quite different. In the English language system, the words used when referring to quantities consist of: first digit numbers (zero to nine), tens, hundreds, thousands. After thousand, multipliers (ten and hundred) are placed in front to show the magnitude of the sum: ten thousand, hundred thousand, million, ten million, hundred million, billion, ten billion, hundred billion, and trillion. Table 1 illustrates the discrepancy between the two systems.

Table 1: Discrepancy between English and Thai Quantity NumberWords and Quantity Formation Systems

English		Arabic Number	Thai	
Multiplier word	Magnitude word		Multiplier word	Magnitude word
	zero to nine	0-9		*Nuai* (หน่วย)
	ten	10		*Sip* (สิบ)
	hundred	100		*Roi* (ร้อย)
	thousand	1,000		*Pun* (พัน)
ten	thousand	10,000		*Muen* (หมื่น)
hundred	thousand	100,000		*Saen* (แสน)
	million	1,000,000		*Lan* (ล้าน)
ten	million	10,000,000	*Sip* (สิบ)	*Lan* (ล้าน)
hundred	million	100,000,000	*Roi* (ร้อย)	*Lan* (ล้าน)
	billion	1,000,000,000	*Pun* (พัน)	*Lan* (ล้าน)
ten	billion	10,000,000,000	*Muen* (หมื่น)	*Lan* (ล้าน)
hundred	billion	100,000,000,000	*Saen* (แสน)	*Lan* (ล้าน)
	trillion	1,000,000,000,000	*Lan* (ล้าน)	*Lan* (ล้าน)

The above table reflects that the interpreting of sums with multiplier words requires more mental energy than the interpreting of sums without multiplier words since it involves an additional analytical step. Take for example the interpreting of the sum "ten billion" for which a two-step analysis is required. The first step involves conceptually linking "billion" to *"pun lan"* (พันล้าน) while the second step involves taking into account the multiplier word "ten" and doing the Math to come up with a final understanding that "ten billion" in English is equivalent in meaning to *"muen lan"* (หมื่นล้าน) in Thai, and not *"sip pun lan"* (สิบพันล้าน), formed by pairing "ten" with *"sip"* (สิบ) and "billion" with *"pun lan"* (พันล้าน). This additional step is required only when interpreting from English to Thai sums containing multiplier words, but when interpreting quantity numbers without a multiplier word, the interpreter can simply pair words directly from the source and target languages. Take for example the case when interpreting "billion", the interpreter

can merely pair the words "billion" and *"pun lan"* (พันล้าน) to come to a final understanding of the sum. Table 2 illustrates where additional steps are required in the interpreting of certain quantity numbers from English to Thai.

Table 2: Number of Analytical Steps Required in Interpreting Certain Quantity Numbers from English to Thai

Arabic Number	English Verbal Input	Analytical Steps Required	Thai Verbal Output
1,000	thousand	1. thousand = *pun* (พัน)	*pun* (พัน)
10,000	ten thousand	1. thousand = *pun* (พัน) 2. *pun* (พัน) x 10 = *muen* (หมื่น)	*muen* (หมื่น) (not *sip pun*-สิบพัน)
100,000	hundred thousand	1. thousand = *pun* (พัน) 2. *pun* (พัน) x 100 = *saen* (แสน)	*Saen* (แสน)
1,000,000	million	1. million = *lan* (ล้าน)	*Lan* (ล้าน)
10,000,000	ten million	1. Ten million = *sip lan* (สิบล้าน)	*sip lan* (สิบล้าน)
100,000,000	hundred million	1. Hundred million = *roi l an* (ร้อยล้าน)	*roi lan* (ร้อยล้าน)
1,000,000,000	one billion	1. billion = *pun lan* (พันล้าน)	*pun lan* (พันล้าน)
10,000,000,000	ten billion	1. billion = *pun lan* (พันล้าน) 2. *pun lan* (พันล้าน) x 10 = *muen lan* (หมื่นล้าน)	*muen lan* (หมื่นล้าน) (not *sip pun lan*-สิบพันล้าน)
100,000,000,000	hundred billion	1. billion = *pun lan* (พันล้าน) 2. *pun lan* (พันล้าน) x 100 = *saen lan* (แสนล้าน)	*saen lan* (แสนล้าน) (not *roi pun lan*-ร้อยพันล้าน)
1,000,000,000,000	Trillion	1. trillion = *lan lan* (ล้านล้าน)	*lan lan* (ล้านล้าน)

From the above table, one can see that when interpreting from English to Thai quantity numbers in the magnitudes of ten thousand, hundred thousand, ten billion and hundred billion, an additional step is required to analyze the source message. Following Gile's (2009) Effort Model of simultaneous interpreting, the additional step required may put extra burden on the mental capacity used and according to the Tightrope Hypothesis, interpreters already work close to their maximum capacity (Gile, 2001) so any increased demand for mental

effort may disrupt the process. Further to this, we cannot rely on memory alone, either. Numbers are very difficult to remember without notes (Gillies, 2014). Memory is employed at a cost (reduced mental resources), and does not work so well for details and unfamiliar content (like numbers). Memory must be supplemented by some additional "prosthesis" such as external memory in the form of notes (Setton & Dawrant, 2016); therefore, any technique or tool to reduce the mental exertion and help manage the efforts simultaneously at work would be beneficial in contributing to better quality output. It has been suggested that in simultaneous interpreting, interpreters perform better when they write down the numbers they come across (Tepintrapirak, 2016). In this context, note-taking is proposed as a tool to prevent cognitive saturation at a very critical time in simultaneous interpretation, when quantity numbers are present in the source speech.

The Mixed Method for Note-taking of Quantities

It seems to be a general practice to write down sums by using a series of Arabic numbers; for example, when taking note of the aural input "25,000,000,000", one may write down the number twenty-five followed by nine zeros. This is the most common reaction people would have when asked to write down sums. Although there is no negative implication to this practice if there is sufficient time to write down all the numbers, having to write down too many numbers in a limited timeframe could create a much higher demand on the use of mental energy in simultaneous interpreting; for example, time will be unproductively spent on thinking about how many zeros go into the sum. Forcing the brain to think about the correct numeral representation of the sum also creates unnecessary strain on mental capacity. It has been found that ready-made number charts like year conversion charts (Christian era-Buddhist era) combined with note-taking contributes to better output in the

interpreting of numbers (Tepintrapirak, 2016). Further to the above tool and technique, this paper proposes the mixed method note-taking as a solution to help reduce mental exertion when interpreting quantity numbers. The mixed method note-taking technique involves writing down quantity numbers by using a combination of Arabic numbers and using abbreviations to represent magnitudes. The digits are written down in sets separate from one another, i.e., when using the mixed method it will not be necessary to write down nine zeros for "25,000,000,000", but to merely write "25b". When faced with very complex quantities such as "25,459,124,087", the interpreter can merely write down "25b/459m/124t/87, which is shorter and easier to read out in the production phase. Notes of this sort may also help reduce mental energy required in the target language production because the interpreter is able to more easily and more directly obtain information from the deconstructed parts; for example in English to Thai interpreting, the interpreter looks at "25b/459m" to produce the target language rendition of "*song muen ha pun si roi ha sip kao lan"* (สองหมื่นห้าพันสี่ร้อยห้าสิบเก้าล้าน-twenty five billion four hundred fifty nine million) before looking at "124t/87" to produce the target language output "*nueng saen song muen si pun pad sip chet"* (หนึ่งแสนสองหมื่นสี่พันแปดสิบเจ็ด-one hundred twenty four thousand eighty seven). This technique facilitates a more simple analysis process because the sum is broken into smaller parts and each part is analyzed individually before being combined for the final output. Thus the mixed method of note-taking may produce even better outcome in the interpreting of numbers. Table 3 illustrates how the deconstructed parts of notes taken contribute to more efficient use of mental energy.

Aural input: "twenty five billion four hundred fifty nine million one hundred twenty four thousand eighty seven" (25,459,124,087)

First Part Analysis: "twenty five billion four hundred fifty nine million" (25, 459, ---, ---)

Second Part Analysis: "one hundred twenty four thousand eighty seven" (--, ---, 124, 087)

Table 3: Example for Formulation of Quantity Number from Mixed Method Notes

Mixed Method Notes Taken	Analytical Steps Involved
25b/459m	1. 5b = *ha pun lan* (พันล้าน)
	2. 25b = *song* (two) *meun* (หมื่น-ten thousand) ha(five) *pun lan* (พันล้าน-billion)
	3. 459m = *si roi ha sip kao* (four hundred fifty nine) *lan* (ล้าน-million)
	4. 2+3 = *song*(two) *meun* (หมื่น-ten thousand) ha(five) *pun* (พัน-thousand) *si roi ha sip kao* (four hundred fifty nine) *lan* (ล้าน-million)
124t/87	5. 4t = *si* (four) *pun* (พัน-thousand)
	6. 24t = *song* (two) *muen* (หมื่น-ten thousand) *si* (four) *pun* พัน-thousand)
	7. 124t = *nueng* (one) *saen* (แสน-hundred thousand) *song* (2) *muen* (หมื่น-ten thousand) *si* (four) *pun* (พัน-thousand)
Final Output (oral rendition)	8. 4+7 = *song* (two) *meun* (หมื่น-ten thousand) ha (five) *pun* (พัน-thousand) *si roi ha sip kao* (four hundred fifty nine) *lan* (ล้าน-million) *nueng* (one) *saen* (แสน-hundred thousand) *song*(two) *muen* (หมื่น-ten thousand) *si* (four) *pun* (พัน-thousand)

When rendering the message in the target language (Thai), the interpreter can economize on his use of memory (M). He will be facilitated by the notes, which he has taken in various parts. The interpreter can look at the first part of the notes "25b/459m", and perform a more direct analysis to formulate his rendition into the target language. He will first read "25b" and recognize that "5b" is interpreted into Thai as *ha pun lan* (ห้าพันล้าน-five billion); therefore, "25b" is interpreted into Thai as *song muen ha pun lan* (สองหมื่นห้าพันล้าน-twenty five billion). Next, the interpreter will look at "459m" and understand that the word "million" can be directly replaced by the word *"lan"* (ล้าน-million), and will formulate the rendition by combining direct translations of "459" and "m" (million) to come up with *si roi ha sip kao lan* (สี่ร้อยห้าสิบเก้าล้าน-four hundred fifty nine million). He then combines the first and second parts of his analysis to produce the rendition of *song muen ha pun si roi ha sip kao lan* (สองหมื่นห้าพันสี่ร้อยห้าสิบเก้าล้าน-twenty five billion four hundred fifty nine million). For the second portion of the sum, the interpreter can look at "124t/87" in his notes, and in a similar manner, perform an analysis that "124t" is equivalent to *nueng saen song muen si pun* (หนึ่งแสนสองหมื่นสี่พัน-one hundred twenty four thousand), and "87" is equivalent to *pad sip chet* (แปดสิบเจ็ด-eighty seven). The interpreter then combines the various sections together to produce the final rendition of *song muen ha pun si roi ha sip kao lan nueng saen song muen si pun pad sip chet* (สองหมื่นห้าพันสี่ร้อยห้าสิบเก้าล้านหนึ่งแสนสองหมื่นสี่พันแปดสิบเจ็ด-twenty five billion four hundred fifty nine million one hundred twenty four thousand eighty seven).

When interpreting between languages of very different structures, the cognitive load involved is greater than when interpreting between languages with readily transferable lexical equivalents (Seeber & Kerzel, 2012). The mixed method for

note-taking provides a more systematic approach to tackling quantities in interpreting. When taking notes, instead of directly writing down numeral representations of the sums, the interpreter performs a structural analysis of the quantity and deconstructs the different parts before writing them down separate from one another. Such compartmentalization allows for more ease in reading the notes and reformulating the target language rendition, therefore contributing to more economical usage of memory (M) and coordination (C), and providing added mental capacity for production (P).

The Experiment

In order to determine if the mixed method for note-taking produces better accuracy outcome for beginner level interpreting students in the English to Thai simultaneous interpreting of quantity numbers, a pre-test was administered to 7 fourth year undergraduate students having gone through a semester's training in consecutive interpreting and two months of training in simultaneous interpreting. In this case, the entire class consisted of only 7 students as interpreting classes are usually small and the English-Thai language combination created even more limitations to the number of subjects studied. However, since the students participating in this experiment were the only ones studying English to Thai simultaneous interpretation at undergraduate level at that time, and no other institutions were known to offer English to Thai simultaneous interpreting courses at undergraduate level, it was deemed that they were the total undergraduate population for this language pair. The subjects' mother tongue was Thai but all were fluent in English, having studied it for 16 years. The test consisted of 18 recorded sentences, each containing one sum, read out by an English language native speaker. The sums appearing in the test were in the ten thousand, hundred thousand, million, ten million, hundred million, billion, ten

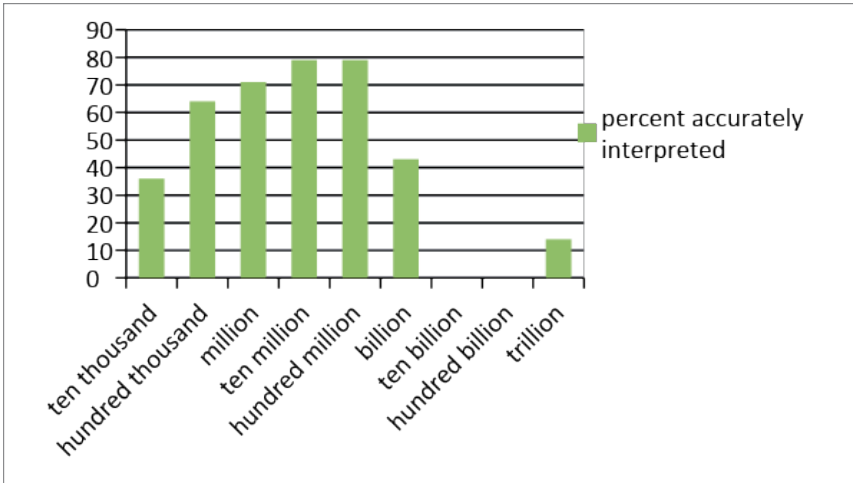
billion, hundred billion and trillion magnitudes. In each sum, only the highest magnitude was expressed in numbers one to nine while the other digits were expressed in zeros (i.e., 1,000-one thousand, 45,000-forty five thousand, 796,000-seven hundred ninety six thousand, etc. Only the highest magnitude was expressed in numbers other than zero.) For each magnitude, there were two sentences, making up a total number of 18 sentences and 18 sums. In a recording, the sentences were read out to the students by a native speaker of English at a speed of approximately 120 words per minute and the interpretation was recorded. The test was administered in a language lab where the students listened to the source message from their headphones. A pre-test was given at the beginning of the experiment but prior to the pre-test, students were asked to take another test consisting of the same messages as the pre-test minus the numbers to make sure they were capable of interpreting the other content parts of the source messages. During the pre-test, students were free to take notes using any method of their choice. The next step was to provide training to the students on the mixed method note-taking for the English to Thai interpreting of sums. After two months or 24 hours of training and practice, during which they received no other training on the interpreting of quantity numbers, the students were asked to take a post-test, which was of the exact same content as the pre-test. The tests were graded and scores were compared.

The grading criterion was set at total accuracy, meaning only renditions which were accurate in every digit were given a score. To illustrate, suppose the number in the source message was "two hundred forty seven thousand" (247,000), only students who said "*song saen si muen chet pun"* (the exact-to-digit correct interpretation of 247,000) were given a score. Others who provided "estimates" (for example, *song* saen-200,000) or "similar quantities"

(for example, *song saen chet muen si* pun-274,000) were not given a score. Thus in the grading, an accurately interpreted sum was a sum that was equivalent to the source language sum in every digit, without omissions, approximations or misrepresentations. In grading, only the numbers (sums) were taken into account-the other content parts were disregarded.

In the pre-test, it was found that from the 18 attempts (each student having made 2 attempts) made to interpret sums of various magnitudes, the magnitudes of "ten million" (79% accuracy) and "hundred million" (79% accuracy) were the ones most correctly interpreted while sums in the magnitudes of "ten billion" (0% accuracy) and "hundred billion" (0% accuracy) were the least correctly interpreted ones. In between were the magnitudes of "trillion" (14% accuracy), "ten thousand" (36% accuracy), "billion" (43% accuracy), "hundred thousand" (64% accuracy), and "million" (71% accuracy). Results showed that students possessed the ability to interpret sums not requiring complex degrees of analysis. For "million", "ten million" and "hundred million", it was possible to perform a direct pairing of lexical equivalents (million = *lan* (ล้าน), *ten* = sip (สิบ), *hundred* = roi (ร้อย)), which may have been a reason why the students scored highly for these magnitudes. On the other hand, the sums "hundred thousand", "ten billion" and "hundred billion" required a more complex analysis of meaning and involved an additional analytical step. The students needed to begin their analysis with a lexical pairing (thousand = *pun* (พัน), billion = *pun lan* (พันล้าน)) before going on to multiply the sums (thousand x 100 = hundred thousand or *"saen"* (แสน), billion x 10 = ten billion or *"muen lan"* (พันล้าน x 10 = หมื่นล้าน), and billion x 100 = hundred billion or *"saen lan"* (พันล้าน x 100 = แสนล้าน)) to produce a rendition. Figure 2 provides a picture of accuracy results.

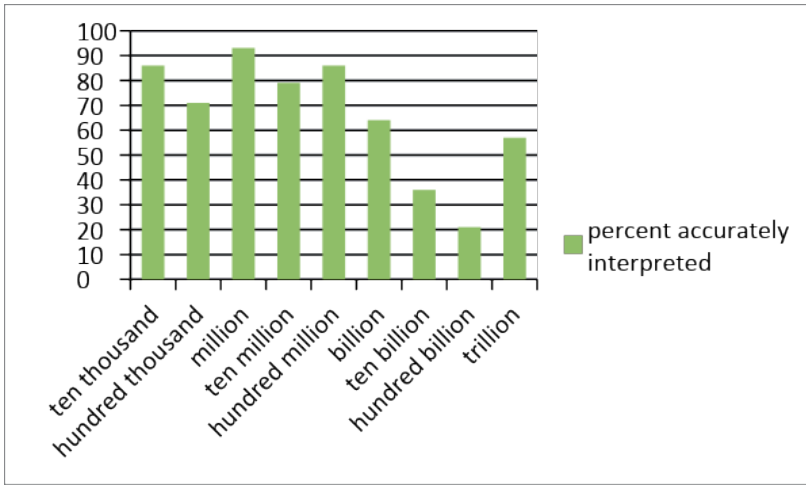
Figure 2: Pre-test Accuracy Result for English to Thai Simultaneous Interpreting of Sums



From the post-test, it was found that most sums were accurately interpreted. The most accurately interpreted magnitude was the "million" (93% accuracy) and, like in the pre-test, the least accurately interpreted magnitudes were the "ten billion" (36% accuracy) and "hundred billion" (21% accuracy) magnitudes. In between were the magnitudes of "trillion" (57% accuracy), "billion" (64% accuracy), "hundred thousand" (71% accuracy), "ten million" (79% accuracy), "ten thousand" (86% accuracy), and "hundred million" (86% accuracy). The results were in line with the assumption that students would score higher for the interpretation of magnitudes not requiring complex analytical steps such as "million", "ten million", "hundred million", "billion" and "trillion". For these sums, it was possible for students to perform a direct lexical replacement (million = *lan* (ล้าน), ten = *sip* (สิบ), hundred = *roi* (ร้อย), billion = *pun lan* (พันล้าน), and trillion = *lan lan* (ล้านล้าน) to come up with a rendition. Although there was some

improvement, they continued to score lowly for "ten billion" and "hundred billion", perhaps because an additional analytical step was required to formulate the final rendition (billion = *pun lan* (พันล้าน) x 10 = *muen lan* (หมื่นล้าน), hundred billion = *pun lan* x 100 = *saen lan* (แสนล้าน)). Improvement was observed for the magnitudes "ten thousand" (from 36% to 86% accuracy) , "hundred thousand" (from 64% to 71% accuracy), "ten billion" (from 0% to 36% accuracy) and "hundred billion" (from 0% to 21% accuracy), suggesting the mixed method note-taking was becoming helpful to the students.

Figure 3: Post-test Results for the English to Thai Simultaneous Interpreting of Sums



A comparison of the pre- and post-test scores showed different degrees of change in the subjects' interpreting performance for the various magnitude numbers. As shown in Table 4, the pre- and post-test score difference for interpreting numbers in the magnitude of ten thousand was 50%, for the magnitude of hundred thousand the difference was 7%, for the

magnitude of million the difference was 22%, for the magnitude of ten million there was no difference, for the magnitude of hundred million the difference was 7%, for the magnitude of billion the difference was 21%, for the magnitude of ten billion the difference was 36%, for the magnitude of hundred billion the difference was 21%, and for the magnitude of trillion the difference was 47%. The scores reflected improvement. A Wilcoxon Signed Rank Test was performed on the pre- and post-test scores, producing a W-value of 0 where the critical value of W for N = 8 at $p \leq 0.05$ is 3, showing the result to be significant at $p \leq 0.05$.

Table 4: Comparison of Pre - and Post - Test Accuracy Scores

Magnitude	Pre-test Percentage of Accurate Renditions	Post-test Percentage of Accurate Renditions	Difference	Wilcoxon Signed Rank
Ten thousand	36	86	50	-8
Hundred thousand	64	71	7	-1.5
Million	71	93	22	-5
Ten million	79	79	0	n/a
Hundred million	79	86	7	-1.5
Billion	43	64	21	-3.5
Ten billion	0	36	36	-6
Hundred billion	0	21	21	-3.5
trillion	14	57	43	-7

Analysis and Way Forward

The high percentage of accuracy for the magnitudes "million" (71% accuracy), "ten million" (79% accuracy) and "hundred million" (79% accuracy) from the pretest concur with the concept postulated in Gile's (2009) Effort Model as the analytical step required to interpret numbers of these magnitudes is limited to only one thus the interpreting does not require use of a heightened level of mental resource or effort. In addition, when interpreting numbers of this magnitude, the subjects had available to them lexical equivalents which could readily be paired with the words uttered in the source language; for example "million" is readily paired with *"lan"* (ล้าน-million), "ten million" is readily paired with "*sip lan"* (สิบล้าน-ten million), and "hundred million" is readily paired with *"roi lan"* (ร้อยล้าน-hundred million). Due to the ease of analysis involved, the available mental capacity was greater than the required mental resources, allowing the subjects to efficiently manage and coordinate the efforts used (L+M+P+C). In this circumstance, the "tightrope" was able to withstand pressure caused by the simultaneous use of the efforts.

Conversely, the accuracy rate declined significantly for the magnitudes "ten billion" (0% accuracy) and "hundred billion" (0% accuracy) since the interpreting of these sums requires a more complex level of analysis whereby available mental resources might be insufficient. In the Thai language, there is no direct lexical equivalent for 'ten billion" or "hundred billion". To interpret these sums, the subjects were required to perform a two-step-analysis: first, to understand the meaning of billion, and second, to multiply that concept by ten or by one hundred. The imposed additional analytical step called for the use of mental resource at a level greater than was available and,

in this circumstance, the "tightrope" was not able to withstand pressure from the exertion of the efforts, which led to failure.

In the middle of the two extremes, we find the sums "ten thousand" (36% accuracy), "hundred thousand" (64% accuracy), "billion" (43% accuracy) and "trillion" (14% accuracy) interpreted with varying degrees of accuracy. It is yet unclear why the magnitudes "ten thousand" and "hundred thousand", which required more complex degrees of analysis, were interpreted more successfully than expected. One contributing factor might be the subjects' familiarity with numbers of these magnitudes, which led them to readily perform mental lexical pairings of the words in the source and target languages. It is also yet unclear why the subjects were not able to accurately interpret the magnitudes "billion" and "trillion" despite the sums requiring limited degrees of analysis. One probable cause might be their lack of knowledge about the meaning of the two words, which made them unable to do a lexical pairing. Perhaps further research is needed to explain this outcome, but overall, the pretest results suggests that the interpreting of certain sums requiring additional analytical steps is more prone to error, as reflected in the table below.

Table 5: Level of Complexity in Meaning Analysis of Quantity Words and Accuracy Rate in Simultaneous English to Thai Interpretation for Beginner Level Interpreting Students

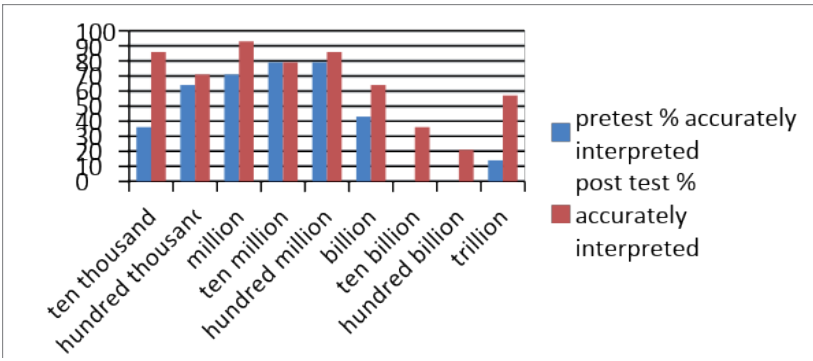
Sum	Analysis Step 1	Analysis Step 2	Percentage of Accuracy
ten thousand	thousand = *pun* (พัน)	*Pun* (พัน) x 10 = *muen* (หมื่น)	36
hundred thousand	thousand = *pun* (พัน)	*Pun* (พัน) x 100 = *saen*	64

		(แสน)	
million	Million = *lan* (ล้าน)	-	71
ten million	Ten = *sip* (สิบ) Million = *lan* (ล้าน)	-	79
hundred million	hundred = *roi* (ร้อย) million = *lan* (ล้าน)	-	79
billion	billion = *pun lan* (พันล้าน)	-	43
ten billion	billion = *pun lan* (พันล้าน)	*pun lan* (พันล้าน)x 10 = *muen lan* (หมื่นล้าน)	0
hundred billion	billion = *pun lan* (พันล้าน)	*pun lan* (พันล้าน) x 100 = *saen lan* (แสนล้าน)	0
trillion	trillion = *lan lan* (ล้านล้าน)	-	14

The post-test results suggest that the mixed method note-taking creates more efficiency in the recording of meaning and message reformulation while contributing to improved outcomes in the interpreting of quantity words. As seen from the table below, the level of accuracy was improved for all magnitudes, notably in the magnitudes of “ten thousand” (50% improvement), “ten billion” (36% improvement) and “hundred

billion" (21% improvement). Such improvement might be attributed to the availability of a more efficient tool for the recording of meaning and its facilitation in reducing the degree of complexity for target language message reformulation. As explained above, the mixed method note-taking allowed the subjects to directly write down abbreviated forms of the words they heard in the source message without having to involve additional analytical steps as when writing down complete numeral forms. In the situation where mixed method notes were employed, the subjects were able to make more efficient and economical use of their mental resources. They were able to better manage the efforts so that the mental requirement did not exceed the available capacity. Likewise, in the reformulation, the subjects were able to more easily reconstruct their messages from the mixed method notes without having to involve themselves in unnecessary additional steps of analyses. This improved efficiency resulted in better accuracy as shown in the comparison below.

Figure 4: Comparison of Pre- and Post-Test Accuracy Percentage



Finally, it is interesting to note that the errors found in this experiment may be categorized into three types: omission,

approximation and misrepresentation. Omission was when the subject did not provide any interpretation of the sum at all. Approximation was when the sum was interpreted by providing an approximate value, i.e., 135,000 was interpreted as 100,000. Misrepresentation was when an attempt was made to provide a complete interpretation of the sum but the numbers were wrong. It would perhaps be helpful to know what strategies students employ in the English to Thai simultaneous interpreting of sums. There is room for more research on this topic, where findings may shed light on possible solutions to the number problem in simultaneous interpreting.

Conclusion

It was found that the subjects' accuracy in the simultaneous interpreting of sums from English to Thai improved after they employed the mixed method for note-taking. The subjects were provided with an effective tool which helped to improve efficiency in recording the aural input of quantity words. For complex quantities, the mixed method note-taking allowed the meaning components to be compartmentalized, making it easier for the interpreter to see different compositions of the sum and provided more clarity for him in putting together different meaning aspects during the reformulation stage. In brief, the mixed method note-taking was found to be a user-friendly tool for beginner level interpreting students when performing English to Thai interpreting of quantity words.

However, this experiment is only an initial testing of the waters. More research needs to be pursued to confirm the advantage of this technique/tool. Much remains to be studied about factors affecting accuracy in quantity number interpreting and quality enhancement strategies, and much remains to be studied about number related cognitive saturation in interpreters of various groups, both experienced and novice. Interpreters are

regularly faced with the issue of having to interpret complex quantity numbers in their work. Some are very talented and have no problem in gracefully transferring the meaning of these sums from source to target language. Unfortunately, the majority struggle, in particular with long and complex sums; therefore, any tool or method to help overcome this major obstacle would be most welcomed.

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