

# **Thai Students' Production of English Coda Clusters: An Experiment on Sonority with Thai University Students Taking an English Fundamental Course**

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Date Received: 23 July 2019   Revised: 19 November 2019   Accepted: 21 January 2020

## **Abstract**

In studies of English language learning and teaching, phonological development of second language (L2) learners has received considerable attention. Investigation of phonological acquisition, as well as problematic areas, are useful to predict difficulties that L2 speakers of English may confront when perceiving and producing particular sounds. Consequently, this research was initiated to understand how Thai students of English produce English coda clusters patterning Consonant-stops. To predict the areas of difficulty in producing such clusters, use was made of the Universal Principle (Sonority Sequencing Principle), together with the Markedness Differential Hypothesis established by Eckman (1977). This case study involved participation of 10 students who were taking a third fundamental English course at King Mongkut's University of Technology, Thonburi, Thailand. The students were asked to produce target sounds in cluster elicitation tasks. The tasks required students to produce the target clusters in both formal and natural situations. Areas of difficulty in producing clusters for Thai learners of English were identified, though the hypothesis generated was not confirmed. Deletion and substitution were frequently used as ways to modify problematic clusters.

**Keywords:** *Articulatory phonetics, English coda clusters*

## **Introduction**

In Thailand, the influential role of English as a means for communication is undeniable since it has been accepted as an international language for decades (Smalley, 1994). However, it should be acknowledged that successful communication is affected by many factors, of which pronunciation is among the key aspects in oral communication. Kenworthy (1987) noted that mispronunciation may lead to unintelligibility. Therefore, being understood by other people can be a result of having accurate pronunciation at both segmental and supra-segmental levels. In fact, mastering English segmental sounds is not easy, especially for people who learn English as a foreign language (EFL).

Using the Contrastive Analysis Hypothesis (CAH) approach, Lado (1957) suggested the nature of differences between two languages which caused difficulty for learners. Thai learners of English suffer great difficulty in their attempts to articulate accurate sounds, especially final consonants. Certainly, it has been concluded by researchers that Thai EFL learners try to accommodate English sounds with Thai ones due to the absence of these sounds in Thai (Kruatrachue, 1960; Mano-im, 1999; Sahatsathatsana, 2017; Smyth, 2001). Kanokpermpoon (2007) also noted that Thai speakers have considerable difficulty in producing English consonants, in which English coda clusters appear particularly problematic. An empirical study is needed to confirm this hypothesis. Hence, the aim of the present investigators was to determine how Thai learners of English articulate English coda clusters, not only by looking at differences between the English and Thai languages, but also at different sonority distances between the two segments within an English cluster. The results could be interesting as they can extend the explanation of Thai EFL learners' production of English codas.

## **Literature Review**

### ***Contrastive Analysis Hypothesis***

The English phonological development of non-native speakers has been among the most interesting areas to study in the field of English language teaching. The *Contrastive Analysis Hypothesis*, developed by Lado (1957), emerged as the first modern approach to investigate the areas

of difficulties that non-native learners may experience. The theory indicates that differences between the native and target languages would cause difficulty that affects learners' acquisition, while similarities would not. Kanokpermpoon (2007) concluded that sounds of English that do not exist in the Thai language are likely to pose a great challenge for Thai learners of English. Table 1 illustrates consonant inventories of the Thai and English languages. In particular, the differences are highlighted between the two languages that may pose potential problems for Thai learners of English.

**Table 1.** Thai and English Consonant Inventories (Kanokpermpoon, 2007, p. 10)

**Table 1.1.** Thai Consonant Inventory

|                  | Bilabial            | Labio-dental | Alveolar            | Lamio-prepalatal      | Palatal | Velar               | Glottal |
|------------------|---------------------|--------------|---------------------|-----------------------|---------|---------------------|---------|
| <b>Plosive</b>   | p<br>p <sup>h</sup> | b            | t<br>t <sup>h</sup> | d                     |         | k<br>k <sup>h</sup> | ʔ       |
| <b>Nasal</b>     |                     | m            |                     | n                     |         | ŋ                   |         |
| <b>Fricative</b> |                     | f            | s                   |                       |         |                     | h       |
| <b>Affricate</b> |                     |              |                     | tc<br>tc <sup>h</sup> |         |                     |         |
| <b>Tap</b>       |                     |              |                     | r                     |         |                     |         |
| <b>Lateral</b>   |                     |              |                     | l                     |         |                     |         |
| <b>Semivowel</b> | (w)                 |              |                     |                       | j       | w                   |         |

**Table 1.2.** English Consonant Inventory

|                    | Bilabial | Labio-dental | Dental | Alveolar | Post-alveolar | Palatal | Velar | Glottal |   |   |
|--------------------|----------|--------------|--------|----------|---------------|---------|-------|---------|---|---|
| <b>Plosive</b>     | p        | b            |        | t        | d             | k       | g     | ʔ       |   |   |
| <b>Nasal</b>       |          | m            |        | n        |               |         | ŋ     |         |   |   |
| <b>Fricative</b>   |          | f            | v      | θ        | ð             | s       | z     | ʃ       | ʒ | h |
| <b>Affricate</b>   |          |              |        |          |               | tʃ      | dʒ    |         |   |   |
| <b>Lateral</b>     |          |              |        | l        |               |         |       |         |   |   |
| <b>Approximant</b> | (w)      |              |        | ɹ        |               | j       | w     |         |   |   |

As observed in Table 1, English consonants are richer than those of the Thai language. When it comes to final consonants, the differences seem to be more obvious, as the Thai final consonant system is quite limited in comparison with the English final consonant inventory. Jantharat (1995) showed that Thai has a fairly large inventory of consonants in the onset position, but a smaller inventory in the coda position. In fact, while English allows up to 21 consonants, Thai only allows eight final consonants. These are described in the 'Matra' system as /k<sup>ʔ</sup>/ Mae Kok or 'ก', /t<sup>ʔ</sup>/ Mae Kod or 'ค', /b/ Mae Kop or 'บ', /ŋ/ Mae Kong or 'ง', /n/ Mae Kon or 'น', /m/ Mae Kom or 'ม', /y/ Mae Koeiy or 'ย', /w/ Mae Kew or 'ว' (Noss, 1964). Additionally, a final consonant cluster is not allowed in spoken Thai language, while up to four-member consonant clusters such as texts /teksts/ or prompts /pɒmpts/ are allowed in English.

The difficulty in producing coda clusters among Thai learners of English has been recognized in several studies, such as by Patibat and Cochran (1997), and Mano-im (1999). To scope the study, different types of two-member coda clusters were investigated. As mentioned, *transfer*, which is the focus of CAH, predicts that such codas create great challenge for Thai speakers to produce (Kanokpermpoon, 2007). However, it does not make any prediction on the level of difficulty between different coda clusters. Based on observations from other studies, it is worth considering alternative methods to examine how Thai learners of English produce different two-segment coda clusters. For such a purpose, the Markedness Differential Hypothesis developed by Eckman (1977) was considered.

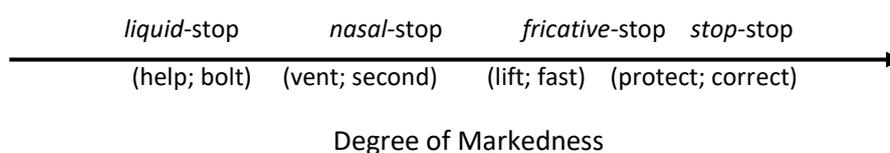
### **Markedness Differential Hypothesis**

The Markedness Differential Hypothesis (MDH) introduced by Eckman (1977) is well-known for its predictive ability in two areas, namely implicational universals, and differences between the native language and target language. According to the theory, the areas of target language that are different and more marked than the native language are likely to be more difficult to acquire (Eckman, 1977). In this study, a stronger form of MDH (termed Interlanguage Structural Conformity Hypothesis—ISCH) was favored, as it takes into account these universal principles to explain how Thai EFL learners produce marked sounds. The ISCH theory determines “the universal generalizations that hold for the primary languages hold also for interlanguages” (Eckman et al., 1989, p. 24). Accordingly, in the present study, ISCH was used to examine the Sonority Sequencing Principle in revealing how Thai learners of English produced English two-segment coda clusters.

### **Sonority Sequencing Principle**

According to Broselow and Finer (1991), the Sonority Sequencing Principle (SSP) refers to the degree of difference in sonority value between two members in the onset or coda. SSP is considered universal as it applies to many languages. According to the theory, each phoneme is believed to have a sonority scale that shows the relative degree of phonological prominence. Trof (1986) developed the scale of sonority to identify different degrees of markedness in consonant clusters. The scale of sonority can be described as Glides > Liquids > Nasals > Fricatives > Stops. This theory can be linked with another principle, namely Minimal Sonority Distance (MSD; Broselow and Finer, 1991). Now, MSD refers to the degree of difference of sonority value between two adjacent segments in onset or coda. According to SSD and MSD, the smaller the distance is, the more marked the cluster becomes. (Broselow & Finer, 1991). For instance, stop + stop (e.g., /kt/, /pt/) is considered to be more marked since the MSD is smaller in comparison with liquid + stop (e.g., /lp/, /lt/).

In order to explain how Thai learners of English produce marked coda clusters using MSD, it is important to restrict the sounds in a particular pattern. In the present study, each stop–fricative, nasal and liquid–was put into examination when they preceded a stop at the coda position. As a stop is the least sonorous among the four consonants, the distance of sonority differs when it is attached to different consonants at coda. Among the two-member clusters investigated, the hypothesis implies that the cluster *liquid-stop* (help; bolt) is easier to articulate, while the coda *stop-stop* (protect; correct) would potentially create the most difficulty as the minimal sonority distance between the two neighboring consonants of the former is greater than the latter. The hypothesis can be described in Figure 1.



**Figure 1.** The Hypothesis of Markedness Hierarchy of English Consonant + Stop Clusters

### **Production of English Coda Clusters and Cluster Modification by Thai Speakers**

In the Thai context, a few studies have been conducted to investigate the ability of Thai students of English to produce final consonantal clusters. The first study was conducted by Mano-im (1999) who investigated the way that Thai students articulate English two-member-consonant clusters and the relationship between articulating ability and gender. The study involved the participation of 30 Grade 11 high-schoolers performing a flashcard articulating test that included one-syllable vocabulary endings with most final clusters found in textbooks, such as /nt/, /nk/, /sk/, /ns/. It was concluded that most students tended to produce both segments in the final clusters, while some students either omitted or replaced one or both consonants of the examined clusters. This also was observed in a study by Sahatsathatsana (2017).

The suggestion is made in Figure 1, which presents the hypothesis utilized in this study, is that Thai learners of English are likely to find final *stop-stop* clusters more problematic than *fricative-stop*, *nasal-stop*, and *liquid-stop* codas as the sonority distance between two segments of the former cluster group is bigger than the latter one. Such an outcome is illustrated by Patibat and Cochran's (1997) study. They investigated how Thai learners of English produced English codas in their speech based on the principles of sonority. Their study used Clement's (1992) framework of Sonority Dispersion, which elaborates on SSP, and illustrates the relationship between level of difficulty and distance between two neighboring sound segments. The researchers discovered that Thais were likely to have problems with the clusters situated at coda positions.

With regards to sound modification, Thai speakers of English are believed to modify complicated phonological features. Broselow (1987) and Lado (1957) suggested that first language (L1) transfer leads to consonant cluster modification. In dealing with problematic clusters, a few studies revealed that Thai speakers tend to substitute the closest consonants available in the Thai inventory (Kruatrachue, 1960; Smyth, 2001). According to Padibat and Cochran (1997), deletion, substitution, and a minor epenthesis were found as ways to modify the problematic clusters. This finding corresponds with many previous studies (e.g., Sherwin, 1999; Trof, 1986). It also indicates that EFL learners tend to modify marked structures more than less marked ones. In addition, students tend to omit less sonorous sounds, while keeping more sonorous ones. For example, *band* tended to be produced as *ban* while *left* was produced as *lef*. Substitution of sounds was also found in Thai speakers of English by some studies such as Smyth (2001) and Kruatrachue (1960). In the present study, the researchers expected to elaborate on this matter as they took the combination of ISCH and MSD to identify how difficult different types of English coda clusters are, and how they are modified.

The research questions that guided this study were:

1. How do Thai learners of English produce two-segment coda clusters with a final stop?
2. How do they modify those clusters?

## **Methodology**

In the present investigation, a quantitative approach (rate of accurate production) was used to measure the participants' ability of articulating English final consonant clusters. Also, sound modification employed by the participants was measured by counting the frequency of this kind of articulation.

## **Participants**

The present study involved 10 undergraduate engineering students at King Mongkut's University of Technology, Thonburi (KMUTT). At the time of this research, they were in their second year and were taking LNG 103: an English for Workplace Communication course. The participants would have passed the compulsory LNG 102 at KMUTT, which is a prerequisite for LNG 103. They are assumed to have reached the Common European Framework of Reference for Languages (CEFR) Level A2: Elementary to Pre-intermediate, as these courses are grounded according to those levels. These students were also assumed to have similar backgrounds, English proficiency, exposure to English, and fields of study. Before data collection, the participants were informed by the researchers of the study's procedures and educational purpose. They understood that their participation, as well as their performance, had no impact on their academic results.

## **Instrument**

A cluster elicitation task was designed to investigate Thai students' production of English coda clusters. It consisted of three tasks, namely Word List Task (WLT), Sentence List Task (SLT) and Picture-based Task (PT). This instrument was developed due to the concern that different findings may be a result of different task types to elicit L2 speech data (Tarone, 1979). For the purpose of collecting meaningful data, the researchers intended to create different environments to elicit participant's articulation, such as reading sentences and answering questions in the third task, rather than relying

only on reading words. The words and sentences were collected by the researchers. These were rechecked by an LNG 102 teacher. Thirty-nine words that fell in different categories were used for a preliminary study involving two second-year students, in order to confirm suitability of the instrument regarding its format and content. Final adjustments were made in which 20 words were used, while other words were deleted on account of their potential lack of familiarity to the participants. The suitability of using 20 words was also reported in the preliminary study, ensuring it did not create tiredness and loss of interest among participants. The word order was based on their appearance in the textbook *Tech Talk*. After adjustments, the final versions of WLT and SLT consisted of 20 words and sentences, including coda clusters with consonant-stop patterns.

The PT consisted of 20 questions. This task was administered as a cluster-elicitation task between the researchers and participants. The participants were asked to answer a list of 20 questions printed with different pictures to guide students' answers. Most pictures were taken from "The Simpsons Workplace Safety Posters" set. The participants were familiar with the pictures because the Simpsons is a popular cartoon, and the characters had also been used in the LNG 102 course. This task was designed to encourage participants to utter target sounds as naturally as possible.

The three tasks were conducted in a sound restricted room with a voice recorder. The word list and sentence list were given to participants for the first two tasks. The participants could take as much time as they needed to read through the material before being recorded. In the third task, pictures were presented while questions were being asked. In this task, it should be noted that the participants' responses were varied. The students could give answers until the target clusters were articulated. There were small breaks before each task. Examples of the three tasks are presented in Table 2.

**Table 2.** Examples of Three Clusters Elicitation Tasks

| Cluster Types         | WLT     | SLT  | PT  |   |
|-----------------------|---------|--|---|---|
| <i>Stop-stop</i>      | protect | The gloves can <u>protect</u> your hands.          |  | Can you describe the picture?<br>(What can this hat do?)              |
| <i>Fricative-stop</i> | lift    | It can <u>lift</u> cars fifteen meters in the air. |  | Can you describe the picture?<br>(What can this machine do?)          |
| <i>Nasal-stop</i>     | tent    | I bring a <u>tent</u> when I go camping.           |  | Can you describe the picture?<br>(Where do they sleep at night?)      |
| <i>Liquid-stop</i>    | belt    | Wearing a <u>seatbelt</u> is necessary.            |  | Can you describe the picture?<br>(What should we wear when we drive?) |

### Data Analysis

To answer the first research question, transcribed speech data were collected from the three tasks. The combination involving ISCH and MSD was used as the framework. Based on the transcription, the production of coda clusters by each student was analyzed and scored. Each score was allocated to the appropriate cluster articulation. Then, the scores were collected and categorized into three groups—low, medium and high-performance. The score interval in this study was five. That

is to say, if a participant received a score less than or equal to 5, the participant was then considered to belong in a low performing group. If the score ranged between 5 and 10, the participant's performance was considered medium, while anything more than 10 was counted as high-performance. The researchers then identified the clusters that caused difficulty for the participants to articulate. The results were compared with the hypothesis presented in Figure 1 for either confirmation or rejection.

To answer the second research question, speech data were analyzed to find potential cluster modification emerging in the participants' speech. The data were put into categories according to different modification types, namely, deletion, epenthesis and substitution. For example, if the participants pronounce /lɪf/; /lɪftə/ or /lɪp/ for the target word lift /lɪft/, it was considered deletion of /t/, epenthesis (vowel /ə/ was inserted), and substitution of /p/ for the *fricative-stop* coda /ft/. The ways that the participants accommodated difficult coda clusters were tabulated, and the differences were recorded in the form of percentages.

### Data Presentation and Interpretation

Findings from the cluster elicitation tasks are organized in this section based on the research questions being addressed.

#### RQ 1: How do Thai speakers produce coda clusters Consonant + Stop in English?

The performance of 10 participants articulating clusters in different groups from *stop-stop*, *fricative-stop*, *nasal-stop* and *liquid-stop* is recorded in Table 3.

**Table 3.** Participants' Coda Cluster Production among Four Cluster Groups

| Participant | Cluster Groups   |                       |                   |                    |
|-------------|------------------|-----------------------|-------------------|--------------------|
|             | <i>Stop-stop</i> | <i>Fricative-stop</i> | <i>Nasal-stop</i> | <i>Liquid-stop</i> |
| 1           | 0                | 1                     | 7                 | 11                 |
| 2           | 0                | 0                     | 5                 | 2                  |
| 3           | 0                | 0                     | 3                 | 0                  |
| 4           | 1                | 0                     | 5                 | 3                  |
| 5           | 6                | 7                     | 6                 | 9                  |
| 6           | 3                | 6                     | 7                 | 8                  |
| 7           | 1                | 0                     | 5                 | 8                  |
| 8           | 0                | 0                     | 3                 | 1                  |
| 9           | 9                | 9                     | 7                 | 12                 |
| 10          | 0                | 0                     | 4                 | 3                  |

\*0–5: low      6–10: medium      11–15: high

From the results collected, it can be seen that the performance of 10 participants does not conform to the hypothesis generated for this study. According to the hypothesis described in Figure 1, the performance of participants was expected to increase from *stop-stop* to *fricative-stop*, *nasal-stop* and *liquid-stop*, as the former group is considered to be more marked than the latter, due to the sonority distance between two segments of each cluster. However, most participants' performance was categorized as low (five students' performance ranges from 0 to 5) or medium (three students' performance ranges from 6 to 10) across the four cluster groups examined. Only two participants' performance (Participants 1 and 6) increased from lower to higher within a cluster across the four cluster groups examined. What this illustrates is that the degree of markedness in relation to the level of sonority may not play an important role in explaining how Thai students produce different coda clusters.

On the other hand, it is clear that in the 10 participants' production of four cluster groups, most of them performed poorly in articulating the four different types of coda clusters used in the current study. They may have considerable difficulty producing final consonant clusters. Specifically, eight out of 10 participants had difficulty producing coda cluster *stop-stop*, while seven, six and five students

had the same problem in the remaining *fricative-stop*, *nasal-stop* and *liquid-stop* respectively, as their scores were low (ranging from 0 to 5). Only two students (Participants 1 and 9) were deemed high performing, seen through their attempt of producing *liquid-stop* codas. It is safe to suggest that the coda clusters are relatively challenging.

### Stop–Stop

This cluster group contained five tokens in each task. As seen in Table 4, this group of clusters posed a challenge for articulation. Only two participants managed to achieve medium production performance throughout the three tasks. Low production performance was identified in the other eight participants’ speech. In this cluster, surprisingly, participants 1, 2, 3 and 8 did not provide a single accurate articulation.

**Table 4.** Participants’ Production of Stop–Stop Coda Clusters

| Task  | WLT     |         |           |        |         | SLT     |         |           |        |         | PT      |         |           |        |         | Total |
|-------|---------|---------|-----------|--------|---------|---------|---------|-----------|--------|---------|---------|---------|-----------|--------|---------|-------|
|       | correct | protect | architect | insect | connect | correct | protect | architect | insect | connect | correct | protect | architect | insect | connect |       |
| 1     |         |         |           |        |         |         |         |           |        |         |         |         |           |        |         | 0     |
| 2     |         |         |           |        |         |         |         |           |        |         |         |         |           |        |         | 0     |
| 3     |         |         |           |        |         |         |         |           |        |         |         |         |           |        |         | 0     |
| 4     | /       |         |           |        |         |         |         |           |        |         |         |         |           |        |         | 1     |
| 5     | /       |         | /         | /      | /       | /       |         | /         |        |         |         |         |           |        |         | 6     |
| 6     |         |         |           | /      | /       |         |         |           | /      |         |         |         |           |        |         | 3     |
| 7     |         |         |           |        | /       |         |         |           |        |         |         |         |           |        |         | 1     |
| 8     |         |         |           |        |         |         |         |           |        |         |         |         |           |        |         | 0     |
| 9     | /       | /       | /         | /      | /       | /       |         | /         |        |         | /       |         | /         |        |         | 9     |
| 10    | /       |         | /         |        |         | /       |         | /         |        |         |         |         | /         |        |         | 5     |
| Total | 4       | 1       | 3         | 3      | 4       | 3       | 0       | 3         | 1      | 0       | 1       | 0       | 2         | 0      | 0       |       |

\* Accurate production is represented by /

Among the three tasks, the data indicate that most students’ production of coda *stop-stop* clusters drops from WLT to SLT and PT. This suggests that this coda cluster tends to be infrequently found in longer and more natural contexts, rather than in isolated words.

All five words examined containing the cluster *stop-stop* were challenging for the 10 Thai participants to produce, especially in the SLT and PT. Very few participants could produce both members of the target cluster throughout the three tasks. Interestingly, students who failed to produce the coda clusters tended to substitute it with a weakly articulated stop. For instance, the cluster /kt/ was commonly replaced by the weakly articulated consonant [k̚]. This phenomenon will be explained in the discussion section.

### Fricative–Stop

Following *stop-stop*, coda clusters of *fricative-stop* were also a great challenge for the participants. The data are presented in Table 5. The five examined words were distributed among three tasks—WLT, SLT and PT. According to the information collected, the difficulty in articulating this cluster group is reflected in the low performance of most students. To be exact, seven students could not articulate the cluster accurately, while three students’ performed in the medium range. Six students failed to produce the cluster accurately with two consonants articulated, signifying that the cluster appeared to be extremely difficult for some Thai students.

Similar to the previous cluster group, the general trend of dropping articulation performance from the former to the latter task also occurred in this group. It can be seen that the participants were likely to produce the target codas in reading isolated words more frequently than in sentences, or when answering the researchers’ questions.

**Table 5.** Participants' Production of *Fricative* – Stop Coda Clusters

| Task        | WLT  |      |      |       |      | SLT  |      |      |       |      | PT   |      |      | Total |   |
|-------------|------|------|------|-------|------|------|------|------|-------|------|------|------|------|-------|---|
| Participant | desk | lift | last | first | fast | desk | lift | last | first | fast | desk | lift | last | first |   |
| 1           |      | /    |      |       |      |      |      |      |       |      |      |      |      |       | 1 |
| 2           |      |      |      |       |      |      |      |      |       |      |      |      |      |       | 0 |
| 3           |      |      |      |       |      |      |      |      |       |      |      |      |      |       | 0 |
| 4           |      |      |      |       |      |      |      |      |       |      |      |      |      |       | 0 |
| 5           | /    | /    | /    | /     | /    | /    |      |      |       | /    | /    |      |      |       | 7 |
| 6           | /    | /    | /    | /     | /    |      |      | /    |       |      |      |      |      |       | 6 |
| 7           |      |      |      |       |      |      |      |      |       |      |      |      |      |       | 0 |
| 8           |      |      |      |       |      |      |      |      |       |      |      |      |      |       | 0 |
| 9           | /    | /    | /    | /     | /    | /    | /    | /    |       |      | /    |      |      |       | 9 |
| 10          |      |      |      |       |      |      |      |      |       |      |      |      |      |       | 0 |
| Total       | 3    | 3    | 2    | 3     | 2    | 2    | 2    | 1    | 2     | 0    | 1    | 2    | 0    | 0     | 0 |

\* Accurate production is represented by /

All five words containing *fricative*-stop clusters happened to be almost equally challenging for the 10 participants to articulate. Students tended to omit the final stop, while keeping the fricatives. This phenomenon is in line with Clement's theory (1992) regarding two neighboring sounds having different levels of sonority. This finding will also be elaborated in the later section.

### **Nasal-Stop**

Table 6 shows the production of the coda clusters *nasal-stop*. It was found that six Thai participants' showed low performance, while the remaining four were medium performers. None of the students' cluster production was deemed to be in the high-performance group. This indicates that it was not easy for the participants to produce this type of coda cluster.

**Table 6.** Participants' Production of *Nasal* – Stop Coda Clusters

| Task        | WLT   |      |        |       |        | SLT   |      |        |       |        | PT    |      |        | Total |        |   |
|-------------|-------|------|--------|-------|--------|-------|------|--------|-------|--------|-------|------|--------|-------|--------|---|
| Participant | drink | vent | second | clamp | behind | drink | vent | second | clamp | behind | drink | vent | second | clamp | behind |   |
| 1           | /     | /    | /      | /     | /      | /     |      | /      |       |        | /     |      |        |       |        | 7 |
| 2           | /     | /    | /      |       |        | /     |      |        |       |        | /     |      |        |       |        | 5 |
| 3           | /     | /    | /      |       |        |       |      |        |       |        |       |      |        |       |        | 3 |
| 4           | /     | /    | /      |       |        | /     |      |        |       |        | /     |      |        |       |        | 5 |
| 5           | /     | /    |        | /     | /      | /     |      |        |       |        | /     |      |        |       |        | 6 |
| 6           | /     | /    |        | /     | /      | /     |      | /      |       |        | /     |      |        |       |        | 7 |
| 7           |       | /    |        | /     |        | /     |      | /      |       |        | /     |      |        |       |        | 5 |
| 8           |       | /    |        |       | /      | /     |      |        |       |        |       |      |        |       |        | 3 |
| 9           | /     | /    |        | /     |        | /     |      | /      |       |        | /     |      |        | /     |        | 7 |
| 10          | /     | /    |        |       |        | /     |      |        |       |        | /     |      |        |       |        | 4 |
| Total       | 8     | 10   | 3      | 5     | 4      | 0     | 9    | 0      | 4     | 0      | 0     | 8    | 0      | 1     | 0      |   |

\* Accurate production is represented by /

Among the three tasks, the tendency of dropping production of the clusters from WLT to SLT and PT was still noticeable in this group. However, it was found that, among the five words investigated in three tasks, *nasal-stop* /nk/ in *drink* appeared to be much more problematic to produce when it was situated in longer and natural discourse rather than in isolated words. Eight participants could produce it in the first task, while no articulation was found in the remaining two tasks.

After investigating the participants' speech, it was found that the 10 participants tended to delete one or both consonants in order to modify most clusters. However, /nt/ in *vent* did not seem to be problematic for most participants as they could produce such sounds in all three tasks. In the

meantime, /nk/ in *drink* and /nd/ in *behind* and *second* appeared to be more problematic exclusively in SLT and PT tasks, as none of the participants could produce the sounds.

### Liquid–Stop

Table 7 shows the production of *liquid–stop* cluster at the coda position. Five words were introduced in each task. According to the combined framework between *Interlanguage Structural Conformity Hypothesis* and *Minimal Sonority Distance*, among four cluster groups investigated in current study, *liquid–stop* cluster required the least effort to produce due to the greater distance in sonority degrees between the two segments of the clusters in comparison with other cluster groups. Yet, there were low-performing students. Five participants had a score of less than or equal to five. Two students were in the high-performance group (greater than 10), while another three students' performance was deemed medium (from 6 to 10). This suggests that some can produce this cluster group with ease, though it may still be problematic for many others.

**Table 7.** Participants' Production of *Liquid–Stop* Coda Clusters

| Task  | WLT  |      |      |           |      | SLT  |      |      |           |      | PT   |      |      |           |      | Total |
|-------|------|------|------|-----------|------|------|------|------|-----------|------|------|------|------|-----------|------|-------|
|       | belt | fold | help | difficult | bulb | belt | fold | help | difficult | bulb | belt | fold | help | difficult | bulb |       |
| 1     | /    |      | /    | /         | /    | /    |      | /    | /         | /    | /    |      |      | /         | /    | 11    |
| 2     |      |      |      | /         |      |      |      |      | /         |      |      |      |      |           |      | 2     |
| 3     |      |      |      |           |      |      |      |      |           |      |      |      |      |           |      | 0     |
| 4     | /    |      |      |           |      | /    |      |      |           |      | /    |      |      |           |      | 3     |
| 5     | /    |      | /    | /         | /    | /    |      | /    | /         | /    |      |      |      |           | /    | 9     |
| 6     | /    | /    |      | /         |      | /    | /    | /    | /         |      | /    |      |      | /         |      | 8     |
| 7     | /    |      | /    | /         |      | /    |      | /    | /         |      | /    |      |      | /         |      | 8     |
| 8     |      |      | /    |           |      |      |      |      |           |      |      |      |      |           |      | 1     |
| 9     | /    | /    | /    | /         | /    | /    |      | /    | /         | /    | /    |      | /    | /         |      | 12    |
| 10    | /    | /    |      |           |      | /    |      |      |           |      |      |      |      |           |      | 3     |
| Total | 7    | 3    | 5    | 6         | 3    | 7    | 1    | 4    | 6         | 3    | 5    | 0    | 1    | 4         | 2    |       |

\* Accurate production is represented by /

Following the overall tendency of previous cluster groups, performance of participants continued to drop across the three tasks. The clusters being put in natural speech were still challenging for participants to articulate as not more than five students could accurately produce both consonants in each coda cluster. Furthermore, /ld/ in 'fold' appeared to be challenging for Thai participants, since no correct articulation was found in the third task.

As mentioned, /ld/ in 'fold' seems to be very problematic for the 10 participants to produce in PT. At the same time, most of the remaining coda clusters situated in five words examined appeared to be quite difficult for the participants to produce. Among the five words, coda consonantal clusters in 'belt' and 'difficult' are, perhaps, easier for the participants to produce, as a majority could articulate such sounds in isolated words and in sentences.

### RQ 2: How do Thai EFL learners modify two-member coda clusters?

Coda clusters in the form of consonant–stop were considered for the participants of this study. To understand how they dealt with problematic clusters, further investigations regarding cluster modification were completed. The findings are presented as follows.

Table 8 summarizes how the Thai participants modified problematic coda clusters in four different groups, with a total of 150 occurrences of coda clusters in each group. Between the two types of modification diagnosed, deletion appeared more frequently, perhaps to cope with English two-member coda clusters across the three groups: *fricative-stop* (91.3%), *nasal-stop* (96.9%) and *liquid-stop* (69.9%). The cluster group of *stop-stop*, which is considered to be the most marked according to the combined framework between ISCH and MSD, received 82.4% of substitutions. This high tendency

of substituting marked *stop-stop* clusters with weakly released stops may be because the latter sounds are available in Thai language. This feature was found across all who participated in this study. For instance, /kt/ in ‘correct’, ‘architect’, ‘connect’, ‘insect’ is mostly produced with a very weakly released single stop [k], available in Thai. These sounds can be described as  $n [k]$  in Thai Matra. The phenomenon was observed in other studies (e.g., Patibat & Cochran, 1997; Smyth, 2001; Kruatrachue, 1960).

**Table 8.** Thai Students’ Modification of Coda Clusters Patterning *Consonant–Stop*

| Cluster Groups        | Without both Segments Articulated | Coda Cluster Modifications |             |            |
|-----------------------|-----------------------------------|----------------------------|-------------|------------|
|                       |                                   | Type of Modification       | Occurrences | Percentage |
| <b>Stop-stop</b>      | 125                               | Deletion                   | 22          | 17.6       |
|                       |                                   | Substitution               | 103         | 82.4       |
| <b>Fricative-stop</b> | 127                               | Deletion                   | 116         | 91.3       |
|                       |                                   | Substitution               | 11          | 8.7        |
| <b>Nasal-stop</b>     | 98                                | Deletion                   | 95          | 96.9       |
|                       |                                   | Substitution               | 3           | 3.1        |
| <b>Liquid-stop</b>    | 93                                | Deletion                   | 65          | 69.9       |
|                       |                                   | Substitution               | 28          | 30.1       |

In the remaining three groups, failing to produce the target coda clusters, the participants tended to omit the final stop. For instance, ‘fast’ /fast/ was produced as /fas/ while ‘drink’ /drɪŋk/ was produced as /drɪŋ/. The participants modified the *nasal-stop* cluster /nd/ appearing in ‘behind’ /bɪˈhaɪnd/ by omitting both consonants. Similarly, in *liquid-stops*, as the last stop is still commonly deleted, it was also found that some speakers tend to delete both consonants such as /ld/ in ‘fold’ /fəʊld/ resulting in /fəʊ/. This articulation characteristic was found in the speech of six participants.

## Discussion

### *Thai Students’ Production of English Coda Clusters*

The adapted framework used in this study combining two theories, namely: 1) Interlanguage Structural Conformity Hypothesis, which is a stronger form of Markedness Differential Hypothesis (Eckman, 1977), and 2) Minimal Sonority Distance (Browslow and Finer, 1991). The hypothesis generated was not confirmed. According to the framework, the level of difficulty of different sounds should have corresponded with their level of markedness. However, according to the data collected, most students’ coda clusters production performance remained low or medium across the four sound groups examined. A majority of participants found most clusters at the coda difficult to produce. That is to say, the degree of sonority may play a limited role in the difficulty to articulate English coda clusters. In this case, L1 transfer is still a more plausible explanation for such phenomenon.

The findings revealed that most Thai EFL students in this study found coda clusters problematic to produce. As previously mentioned, the transfer from L1 may play a critical role. Kanokpermpoon (2007) extended Lado’s (1957) Contrastive Analysis Hypothesis in the Thai context and confirmed that English clusters, especially codas, are difficult for Thai learners to produce due to their absence in their L1. Sahatsathatsana (2017) confirmed the difficulty of Thai learners in producing English consonantal clusters. An explanation was the influence of the speakers’ L1, since Thai language only allows limited consonants at the coda position.

### *Sound Modification by 10 Thai EFL Learners in Producing Coda Clusters*

Turning to the coda clusters modification, deletion was used as the principal method to accommodate marked codas. Moreover, substitution occurred, especially in *stop-stop* target sounds, seen through the modification of marked *stop-stop* /kt/ with the more familiar weakly released [k].

From this study, the frequent deletion of the final stop consonant, while the first segment is retained within a coda cluster, is in line with Clement’s theory (1992). That is, between two

neighboring sounds within a cluster, if one sound is more sonorous than its neighbor, it tends to be kept while its counterpart is deleted. Using this theoretical framework, Patibat and Cochran (1997) revealed that students tended to omit the less sonorous sounds, while keeping the more sonorous ones. For instance, in this study, as the fixed final stop in the cluster consonant-stop is the least sonorous, it has been noticed that there is a great deal of deletion of such a sound, rather than its preceding *fricative*—nasal or liquid. Smyth (2001) also indicated that Thai speakers generally reduce the coda clusters in the way that the first segment is retained, while the rest is dropped.

While the omission of the first member in consonant-stop clusters was common in four categories of *nasal-stop*, *liquid-stop* and *fricative-stop*, it was interesting that in *stop-stop* clusters group, the students tended to produce the weakly released version of stops that are available in the Thai coda inventory, such as the weakly released version of [k̚]. As a result, substitution was favored in the production of this cluster group. Lado (1957) and Kenworthy (1987) pointed out that non-native English speakers tend to approximate the unfamiliar sounds with the closest sounds available in L1. Since either stops /k/ or /t/ do not occur at the final position in Thai, the weakly released consonants were frequently used by participants of this study to replace problematic clusters. This is in line with Ketkumbonk (2016), who found a great amount of substitution when Thai students simplified difficult stops by using unreleased stops available in the Thai language coda inventory.

*Transfer* is also a suitable explanation for the phenomenon of cluster deletion by a majority of participants, of the *nasal-stop* cluster /nd/ in 'behind', as well as *liquid-stop* clusters. Kruatrachue (1960) noted that since Thai does not have final sounds after the diphthong /ai/, this feature is probably transferred to the way Thai learners pronounce English. For example, in this study, 'behind' /bɪ'haɪnd/ was, most of the time, pronounced as /bɪ'haɪ/. Furthermore, it was found that both segments in *liquid-stop* were also commonly omitted. Kanokpermpoon (2007) cited Ronakiat's (2002) analysis, and confirmed that such challenges arise when Thai students pronounce the dark /l/ at the final position resulting in sound substitution or omission. For instance, in this study, when the liquid /l/ is attached with a final stop /d/ in 'fold' /fəʊld/, it was noticed that most students dropped both segments in the cluster resulting in /fəʊ/. The reduction of /l/ in final clusters was also found in the production of 'bulb' /bʌlb/. Similarly, as the dark /l/ is also problematic, in most of the speech of 10 participants, the sound was commonly deleted, while the final stop was either retained or substituted.

In addition, there was no sign of epenthesis in the speech of the participants. This finding is in line with the study of Patibat and Cochran (1997). They used sonority dispersion to explain how Thai speakers of English produce codas in interlanguage. In their study, epenthesis occurrence was not significant, as it might have been motivated by spelling. Smyth (2001) indicated that epenthesis or insertion usually occur when Thai speakers try to approximate English clusters at the initial position. For example, 'smoke' is produced as 'sa-moke' while frown is produced as 'fa-rown'.

## Conclusions

This study investigated how 10 Thai undergraduate students at KMUTT produce marked coda clusters *liquid-stop*, *nasal-stop*, *fricative-stop* and *stop-stop* using ISCH and MSD as a framework for explanation. The findings confirmed that Thai learners of English may find English coda clusters problematic to produce, similar to what was reported by Kanokpermpoon (2007). This addressed the first research question. On the other hand, the adapted framework did not conform to expectations, as the distance of sonority did not explain the level of markedness resulting in different levels of difficulty when participants produced the target coda clusters. To answer the second research question regarding sound modifications, deletion was a common approach for the production of *fricative-stop*, *nasal-stop* and *liquid-stop*, while substitution was favored for the production of marked *stop-stop* clusters. From this study, several implications were drawn.

First, as L1 transfer still plays the main factor that prevents Thai learners of English from articulating coda clusters with respect to the EFL perspective, this study, hopefully, raises both teachers' and students' awareness towards the problem that Thai speakers may have when they encounter problematic coda clusters such as /kt/ in 'insect' or /sk/ in 'desk'. The phonological

differences between English and Thai should not only be introduced, but also emphasized. Second, International Phonetic Alphabet (IPA) transcriptions should be used in instructions to minimize sound modification. Smyth (2001) stated that the sound approximation of Thai learners was motivated from the way that teachers and English-Thai dictionaries attempt to clarify the sounds of English by providing transliterations in Thai scripts. Instead, to avoid such phenomena, both native and non-native English teachers may also implement the use of IPA transcriptions as aids to explicitly introduce English sounds. Also, students should be equipped with phonetic knowledge that enables them to produce the sounds from printed phonetic symbols. Handcock (1994) confirmed the importance of IPA and suggested that it should be included in the classroom—not only for young learners, but also for those who intellectualize the learning process, particularly adults.

### Limitations

The findings of this study may not be generalizable to other Thai learners of English, especially with regards to the four groups of coda clusters, since the number of participants was small, as well as the sounds experimented with in current the study were rather restricted. It is recommended that other cluster patterns with a bigger group of participants might be examined. Also, with regards to the difficulty in speech transcription of the inaudible weakly released *stop-stop* /kt/, the researchers assumed that students substitute such a cluster with  $n$  [k], which is available in the Thai language. This limitation is quite common in similar studies such as Padibat and Cochran (1997). Future studies should take this constraint into consideration.

### Recommendations for Future Research

More experiments regarding the production of coda clusters by Thai students should be conducted in order to find out whether final clusters omission and substitution are distinctive features of Thai speakers of English. As suggested by Trakulkasemsuk (2012), Thai speakers of English might have managed to develop their own production peculiarities. In the scenario where English becomes a second language in Thailand, and errors in coda consonant clusters are considered a distinct feature of Thai English, these varieties should probably be accepted as an emerging variety of World English.

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