TH variation in Hong Kong English[1]

JETTE G. HANSEN EDWARDS
The Chinese University of Hong Kong
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The current study examines patterns of TH variation in Hong Kong English (HKE). In particular, it examines patterns in the realization of the voiceless interdental fricative /θ/ as the voiceless labiodental fricative [f],[2] a process known as TH-fronting, as well as realization of the voiceless of TH as [s]. Previous research on HKE (Bolton & Kwok 1990; Hung 2000; Deterding *et al.* 2008; Setter *et al.* 2010) has established that TH-fronting is a variable phenomenon in HKE, with both intra- and inter-speaker variation, though no research to date has examined the social and linguistic constraints that govern this phenomenon in HKE. The current study also examines the realization of TH as [s], which has not been documented in previous research on HKE, but was found to be a variant of TH in the current study. This article thus examines the social (defined here as non-linguistic constraints such as gender, medium of instruction and proficiency) and linguistic (syllable position, linguistic environment, stress) factors which impact the realization of TH in HKE and whether these factors differ for the realization of TH as [f] or [s].

Keywords: phonology, TH-fronting, linguistic variation, Hong Kong English

1 Introduction

Research on TH variation in different varieties of English has primarily focused on TH-fronting, defined here as the production of the voiceless dental fricative /θ/ as the voiceless labiodental fricative [f], which has been found to occur in varieties of New Zealand English, Scottish English and British English, amongst others (Wells 1982; Kerswill 2003; Wood 2003; Clark & Trousdale 2009; Schleef & Ramsammy 2013; Stuart-Smith *et al.* 2013). It is particularly pervasive in southern England and appears to be increasing in northern England as well as in Scotland (Kerswill 2003), leading to a growing interest in understanding the social and linguistic factors that govern TH-fronting in these contexts. As such, there now exists a robust body of research (Kerswill 2003; Wood 2003; Clark & Trousdale 2009; Schleef & Ramsammy 2013; Stuart-Smith *et al.* 2013) that has provided insight into how social factors such as gender and socioeconomic class as well as linguistic factors such as stress and lexical category constrain TH-fronting in varieties of English in both England and Scotland.

Research on TH variation in Hong Kong English (HKE) has also focused on TH-fronting, considered a unique feature of the English spoken in Hong Kong by

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[2] The realization of /ð/ as [v] is also called TH-fronting. This process is less common than fronting of the voiceless dental fricative, however, and therefore will not be examined in the current study.

native speakers of Cantonese (Bolton & Kwok 1990; Stibbard 2004; Deterding *et al.* 2008; Setter *et al.* 2010). This is unusual among the varieties of English that are emerging in Asia. While dental fricatives are rare cross-linguistically (Ladefoged & Maddieson 1996), and do not exist in either the phonetic or phonemic inventories of Asian languages that influence the English varieties emerging in Asia – such as Cantonese in Hong Kong; Mandarin Chinese, Tamil and Malay in Singapore; and Malay in Malaysia – speakers of English in these regions typically use either [t] or [s] in place of the voiceless dental fricative. While previous research (Bolton & Kwok 1990; Stibbard 2004; Deterding *et al.* 2008; Setter *et al.* 2010; Sewell & Chan 2010) has established that TH-fronting exists among speakers of HKE, there has not been a detailed investigation of the social and linguistic factors that govern TH-fronting in HKE. This is an important area of investigation as not only do the findings elucidate linguistic variation patterns in HKE, but also, by comparing the findings from HKE with previous research on TH-fronting in England and Scotland, insight can be gained into whether and how patterns of TH-fronting vary across different varieties of English. In addition, the current study examines the realization of TH as [s], which has not previously been documented as a variant of TH in HKE. The existence of [s] raises questions about why this variant of TH is emerging in HKE and whether the factors constraining realization of TH as [f] versus [s] are similar or different. This is the focus of the current study.

2 Literature review

The review of literature will first examine findings from research on TH variation across different varieties of English and particularly varieties of British and Scottish English, with a primary focus on TH-fronting as this phenomenon has been particularly well documented. Research on TH-fronting in HKE will then be examined. Although it is likely that TH-fronting is compelled by different linguistic and social phenomena in HKE, a comparison of findings across different varieties of English allows for conclusions to be drawn in terms of whether patterns for TH-fronting are variety-specific. The realization of TH as [s] will also be discussed, though as noted above, this has not previously been documented for HKE.

2.1 *TH variation in England and Scotland*

The voiceless interdental fricative TH has various realizations across different varieties of English, including [f], [s], [t] and [h]. Of these, the linguistic and social factors constraining the realization of TH as [f], or TH-fronting, have been particularly well documented. Realization of TH as [s] or [h] may also occur in some varieties of Scottish English, though typically in only a few words, while the realization of TH as [t] may occur for speakers of English from New York and as the dental stop [t̪] for some speakers of English from Ireland (Wells 1982; Hickey 2004; Clark & Trousdale 2009).

TH-fronting has been found to be constrained by both linguistic and social factors. In terms of linguistic constraints, it has been found to occur less frequently in words with /r/ after the TH in onset position such as *three* or *through* in some varieties of Scottish English (Clark & Trousdale 2009) as the variant [s] may occur for some speakers in this linguistic environment. It is more likely to occur in syllable coda (e.g. the sounds after a vowel in a syllable such as in *bathroom*) than in syllable onset position (the sounds preceding a vowel in a syllable, such as *something*), and in word-final (e.g. as in *bath*) rather than word-initial position (e.g. as in *things*), particularly in some Scottish varieties of English, as [h], another TH variant, can occur syllable initially for some speakers (Clark & Trousdale 2009; Schleef & Ramsammy 2013). The prevalence of TH-fronting in different word/syllable positions may also be mediated by task type. Stuart-Smith *et al*. (2013) found that TH-fronting occurred more frequently in word-final than in word-initial and least in word-medial (e.g. in the middle of a word as in *nothing*) position in conversation data, whereas it occurred more frequently in word-medial than in both word-final and word-initial position in word-list data. It has also been found to differ in frequency across task types, with higher frequency in more controlled tasks such as a reading passage task than in conversational tasks (Schleef & Ramsammy 2013; Stuart-Smith *et al.* 2013). While this may be surprising, it is likely that differences in both word/syllable position as well as frequency are related to the words (and their frequency of occurrence) in the two tasks, rather than to the tasks themselves. Morphological complexity has also been found to be significant, with TH-fronting occurring more frequently in polymorphemic (multisyllabic as in *something*) than in monomorphemic words (one-syllable words such as *bath*) (Schleef & Ramsammy 2013). Clark & Trousdale (2009) also found evidence of a priming effect on TH-fronting in Scottish English. They examined whether a preceding [f] in the same word would 'prime a following word or segment by making it more quickly retrievable' (2009: 51). They found that if a labiodental occurred in a preceding position in the word, the TH segment was more likely to be realized as a [f].

Some studies also suggest that TH-fronting may be lexically conditioned. In some varieties of Scottish English, it may appear less frequently in words such as *thing*, *think*, and derivatives of *thing* such as *something* and *anything* (Clark & Trousdale 2009), in part due to the use of the [h] variant in these words for some speakers. This is confirmed by research by Schleef & Ramsammy (2013), who compared differences in TH-fronting in London and Edinburgh, with TH-fronting occurring frequently in words such as *think*, *thing* for participants from London. In contrast, participants from Edinburgh had less frequent use of TH-fronting in *think*, *thing* than participants from London, due to the prevalence of [h] in this position.

In terms of social factors, TH-fronting in England and Scotland occurs frequently among young, working-class males, indicating that age, gender and socioeconomic status all constrain TH-fronting (Kerswill 2003; Stuart-Smith *et al.* 2007; Clark & Trousdale 2009; Schleef & Ramsammy 2013). Peer groups/friendships have also been found to significantly affect TH-fronting (Stuart-Smith *et al*. 2007; Clark & Trousdale

2009). In fact, Stuart-Smith *et al.* (2007: 224) suggest that TH-fronting is emerging as a 'youth norm… relatively independent of physical space… and which exist in a "cultural" or ideological space, towards which speakers may orientate'. Interestingly, recent matched guise research (Levon & Fox 2014) on TH-fronting and ratings of professionalism found that TH-fronting appears to be losing its status as a feature of working-class speech in southern England as there were no differences in ratings of professionalism based on the percentage of TH-fronting among participants from southern England. As Levon & Fox (2014) argue, this suggests that TH-fronting may increasingly be viewed as a marker of an 'urban' or 'street' identity rather than socioeconomic status.

The diffusion of TH-fronting across the UK appears to be a relatively recent phenomenon. Some scholars (see Blevins 2004) argue that it is a diachronic sound change that originated from a 'misperception' effect between [θ] and [f]. This may explain why TH-fronting is more pervasive in word-final contexts as the difference in [θ] and [f] is less salient perceptually and articulatorily in word/syllable-final position. This merger then spreads from this environment to 'other perceptually disadvantaged contexts before favourable ones' (Schleef & Ramsammy 2013: 45).

This misperception effect has been found to be a developmental process in the acquisition of TH in first language (L1) acquisition as well as a developmental stage in the production of English [θ] by French second language (L2) learners of English and the perception of [θ] as [f] by Hungarian L2 learners of English (Nemser 1971; Wenk 1979). This misperception most likely stems from the acoustic similarities of the two sounds as both have a low intensity (sound pressure), meaning that they are produced with weaker energy than other fricatives (Tabain 1998). Jongman *et al.* (2000) suggest that English [θ] and [f] are closer in many acoustic respects (spectral peaks, duration of fricative noise and noise amplitude) than are [θ] and [s], possibly leading to more misperceptions between [θ] and [f] than between [θ] and [s], particularly in the early stages of acquisition. It is also possible that TH-fronting is part of a developmental process in the acquisition of TH; in research on French L2 learners of English, Wenk (1979) found that TH was realized as [f] in the early stages of acquisition, followed by [t] in the intermediate stage of acquisition, before [θ] was acquired in the advanced stage of acquisition.

2.2   *TH variation in HKE*

Hong Kong English (HKE) refers to the variety of English spoken by speakers of Cantonese in Hong Kong. English has served as an unofficial as well as official language in Hong Kong since 1841, when Hong Kong Island was ceded to Great Britain after the First Anglo-Chinese War. After the handover of Hong Kong to the People's Republic of China in 1997, English was retained as an official language. Cantonese, the most commonly used language of 93 per cent of the 7.3 million inhabitants of Hong Kong, is also an official language in Hong Kong. After the handover, Mandarin Chinese, the official language of China, was also given official

language status in Hong Kong. Students are taught English from the age of 3, when they enroll in preschool. While English is taught in schools, there is a wide range of English proficiency levels in Hong Kong due to differences in how English instruction is implemented in local government schools. Some primary and secondary schools provide a Chinese Medium of Instruction (CMI), in which Chinese (usually Cantonese but increasingly Mandarin Chinese) is used to teach all subject matter and English is taught as a school subject. Other schools provide an English Medium of Instruction (EMI), in which English is used to teach most subject matter. While most primary schools are CMI, many secondary schools are EMI, as a high level of proficiency in English is required for admission to university in Hong Kong. Universities in Hong Kong use English as either the sole medium of instruction or as a mode of instruction along with Cantonese and/or Mandarin Chinese.

TH variation research on HKE has focused on TH-fronting, widely considered to be a distinguishing feature of HKE in contrast to other varieties of Asian English such as Singapore and Malaysian English. As noted previously, [s] has not been documented as a variant of TH in previous research on HKE. One of the earliest studies to examine TH-fronting in HKE was Bolton & Kwok (1990), who found that it existed in the spontaneous speech data of an educated tertiary student's English. Later research by Hung (2000) employed word lists to elicit a variety of features in HKE and found that one-half of the participants had TH-fronting, and that use of [f] vs [θ] in TH environments was categorical. In contrast, Stibbard (2004) found that use of [θ] or [f] was highly variable across his participants, though this could be due to use of conversation rather than more controlled word-list data, indicating that task type may also impact degree of TH-fronting in HKE, similarly to British and Scottish English.

Research by Deterding *et al*. (2008) found that realization of TH as [θ] or [f] was speaker-dependent, with some speakers having variable usage of [θ] or [f] whereas other speakers were categorical in using either sound. They also found that realization of TH as [θ] or [f] may be related to word position, with greater realization as [f] in final position; this is similar to findings on word/syllable position effects on TH-fronting in varieties of Scottish and British English (Schleef & Ramsammy 2013). The researchers also examined TH-fronting across different lexical items and found that in initial position, it occurred more often on the word *three* than other lexical items. It also occurred frequently on the word *think*. There were no instances of TH-fronting in medial position. TH-fronting was most frequent overall in word-final position, in words such as *youth* and *both*. This indicates that both word position and lexical effects may impact TH-fronting in HKE; however, due to the limited number of tokens in that database, an expanded study is needed to confirm these findings.

As to why TH-fronting exists in HKE, it is most likely triggered by misperception effects between [θ] and both English and Cantonese [f] (/θ/ does not exist in Cantonese). In other words, TH-fronting in HKE may be motivated both by internal factors in English, similarly to other varieties of English, as well as by substratum influence from Cantonese. While both the voiceless and the voiced dental fricatives are rare cross-linguistically and difficult to acquire for both child L1 learners of English as

well as L2 learners of English (Lombardi 2003), the question is why [f] is in variance with TH rather than [s] or [t] for most speakers of HKE, as previous research has found. This is particularly interesting given that Cantonese also has [s] and [t], the sounds that are commonly used in variation or categorically for TH in other varieties of Asian English, including the English of Singapore, Malaysia, Taiwan and China (Deterding *et al.* 2008). For example, [t] is a variant of TH in Singapore and Malaysian English, while [s] is a variant of TH in the English of Taiwan and China (Deterding *et al.* 2008; Rau *et al.* 2009). As noted above, [s] and [t] (and [h]) are also variants of TH in some varieties of English. Chan (2001) and Deterding *et al.* (2008) argue that it may be due to the acoustic similarities of Cantonese [f] and English [θ], and perhaps a greater similarity between English [θ] and Cantonese [f] than between English [θ] and Cantonese [s]. As noted above, acoustic similarities between English [θ] and [f] in contrast to English [θ] and [s] have been suggested as the underlying cause of misperception effects that exist in both L1 and L2 acquisition (see, for example, Nemser 1971; Jongman *et al.* 2000).

As yet, there are no studies that directly investigate misperception of [θ] and [f] in contrast to [θ] and [s] for Cantonese L1 speakers of English, though researchers have examined the misperception of English [θ] and [f]. Chan (2001) found that some of her Hong Kong participants could not perceive a distinction between [θ] and [f] and that these participants also had a higher rate of TH-fronting in production than those who had higher accuracy scores on the perception task, also indicating that perception and production of [θ] and [f] are related. Lau & Wong (2002) examined the perception of [θ] for year 1 secondary (S1) and year 6 (S6) secondary students in Hong Kong and found that S1 students had lower accuracy percentages for perception on a discrimination test than S6 students. This also provides some evidence to support the hypothesis that perception of TH as [f] rather than [θ] is a developmental process in HKE as the S1 students had a lower level of proficiency in English than the S6 students.

It is not clear whether TH-fronting is purely a linguistic phenomenon in HKE, or whether other factors impact TH-fronting in HKE. It is also not clear why [s] is emerging as a variant of TH in HKE and whether differences exist in the realization of TH as [f] or as [s]. The current study attempts to investigate these issues in more detail.

3   Research questions

The study examines the pervasiveness of TH variation for 44 speakers of HKE and whether there is a relationship between medium of instruction (MOI), gender and proficiency, and TH variation. Finally, the study examines which linguistic factors appear to constrain TH variation in HKE. The study thus seeks to answer the following research questions:

1. How pervasive is TH variation in HKE?
2. Which non-linguistic factors constrain TH variation in HKE?
3. Which linguistic factors constrain TH variation in HKE?

4. Do differences exist in terms of which factors constrain realization of TH as [s] or as [f] in HKE?
5. Are patterns in TH variation in HKE similar to or different from patterns found in other varieties of English?

4 Methodology

Data were collected from 44 Hong Kong Chinese students at a large university in Hong Kong. All participants spoke Cantonese as their first language and learned English from the age of 3. All were born and raised in Hong Kong. Twenty-nine (66 per cent) of the participants self-selected as female and 15 (34 per cent) as male on the background questionnaire the participants filled in when they enrolled in the study. All participants attended local Hong Kong government schools at both primary and secondary level: Nineteen (43 per cent) attended CMI schools at both primary and secondary level, while 25 (57 per cent) attended CMI schools at primary and EMI at secondary level. The participants' levels of proficiency were determined by their scores on the Hong Kong Diploma of Secondary Education (HKDSE) or Hong Kong Advanced Level Examination (HKALE). All students who attend local government schools in Hong Kong are required to take the HKALE (prior to 2012) or the HKDSE for entrance to university. The participants' scores on the spoken English portion of either the HKALE or the HKDSE were used to determine proficiency. Of the participants, 22 (50 per cent) were Advanced, 16 (36 per cent) were High Intermediate, and 6 (14 per cent) were determined to have Low Intermediate proficiency. Not surprisingly, there was a relationship between medium of instruction and proficiency in English: of the 19 CMI students, 5 (26 per cent) were Advanced, 9 (47 per cent) were High Intermediate and 5 (26 per cent) were Low Intermediate. In contrast, of the 25 EMI students, 17 (68 per cent) were Advanced, 7 (28 per cent) were High Intermediate, and only 1 (4 per cent) was Low Intermediate. These details can be found in table 1. Participant numbers refers to their Wave file numbers for the data recordings.

Data were collected during one-on-one data collection sessions with the researcher in a soundproof recording studio. Data were recorded as 16-bit wave files on Marantz PMD-661 using a Shure microphone. During the data collection sessions, the researcher focused on eliciting spontaneous data. As such, the researcher asked each participant a range of questions designed not only to engage the participant in a real conversation but also to elicit a wide a range of lexical items. Questions included educational background, hobbies and travel. A total of thirty minutes of conversational data were collected from each participant; in addition, each participant was asked to read a brief word list and reading passage (see appendix) to elicit a wide range of lexical items. Words with TH were embedded in a larger word list. The word-list and reading passage data were combined as a preliminary analysis did not find differences in realization of TH between these two tasks. The word-list and reading data combined are referred to as the read data. The conversation data were first orthographically transcribed by a research assistant and checked for accuracy by the researcher. Once all

Table 1. *Details of the participants*

Participant	Secondary school medium of instruction	Proficiency	Gender
1	CMI	High Intermediate	Female
3	CMI	High Intermediate	Female
4	CMI	High Intermediate	Female
5	CMI	Advanced	Female
7	CMI	Low Intermediate	Male
8	CMI	High Intermediate	Male
9	CMI	Advanced	Male
10	EMI	Advanced	Female
11	CMI	Advanced	Female
15	CMI	High Intermediate	Female
16	CMI	High Intermediate	Female
18	CMI	Low Intermediate	Male
21	EMI	Advanced	Male
22	EMI	Advanced	Male
23	CMI	Advanced	Female
24	EMI	Advanced	Female
27	EMI	Advanced	Female
28	EMI	High Intermediate	Female
30	EMI	High Intermediate	Male
32	EMI	High Intermediate	Female
33	EMI	Advanced	Female
34	EMI	Advanced	Female
35	CMI	High Intermediate	Female
36	EMI	Advanced	Male
37	CMI	Low Intermediate	Female
38	EMI	Advanced	Male
39	EMI	High Intermediate	Female
42	CMI	High Intermediate	Female
44	CMI	High Intermediate	Female
45	CMI	Low Intermediate	Female
46	CMI	Low Intermediate	Female
47	EMI	High Intermediate	Male
48	CMI	Advanced	Male
50	EMI	High Intermediate	Male
52	EMI	Advanced	Female
53	EMI	Advanced	Female
54	EMI	Advanced	Female
55	EMI	High Intermediate	Male
56	EMI	Advanced	Male
57	EMI	Advanced	Male
58	EMI	Advanced	Female
62	EMI	Advanced	Female
65	EMI	Advanced	Female
66	EMI	Low Intermediate	Female

Table 2. *Analysis of TH realization by MOI, gender and proficiency*

Number of participants	Categorical [θ]	TH variation
MOI		
CMI	10	9
n = 19	53%	47%
EMI	10	15
n = 25	40%	60%
Gender		
Female	15	14
n = 29	52%	48%
Male	5	10
n = 15	33%	67%
Proficiency		
Low Intermediate	1	6
n = 7	14%	86%
High Intermediate	8	8
n = 16	50%	50%
Advanced	11	10
n = 21	52%	48%
Total	20	24
N = 44	46%	54%

data had been orthographically transcribed and checked, two trained research assistants transcribed all the data phonetically. Inter-rater reliability was calculated as 94 per cent for the orthographic transcriptions and 92 per cent for the phonetic transcriptions. If a disagreement arose, the researcher checked the transcriptions. In a few rare cases, data had to be eliminated as consensus could not be reached on the transcription. All TH tokens were also coded as belonging to the onset or coda of a syllable. Onset refers to syllable onset, either word-initially, as in the word *thing*, or word-medially, as in the word *something*, where the TH is the onset of the second syllable. Coda refers to syllable coda, either word-finally, as in *bath*, or word-medially, where the TH is the coda of the first syllable as in *bathroom*. When the TH was in medial position in the word, the *Cambridge English Pronouncing Dictionary* (Jones *et al.* 2011) was consulted if questions arose about the status of the TH as the onset or coda of a given syllable. The word *with* was eliminated from the study as it was frequently realized with the voiced dental fricative [ð] or as [d] and not the voiceless TH.

5 Findings

The study examined the pervasiveness of TH variation across the 44 participants. As table 2 demonstrates, of the 44 participants in the study, a slight majority (54 per cent)

Table 3. *Proficiency and TH variation*

Proficiency	Low Intermediate	High Intermediate	Advanced
Categorical [θ]			
Low Intermediate	–	NS	p < 0.05 Z-score: 1.7638
High Intermediate	NS	–	NS
Advanced	p < 0.05 Z-score: 1.7638	NS	–
TH variation			
Low Intermediate	–	p < 0.05 Z-score: 2.1822	p < 0.05 Z-score: 1.7638
High Intermediate	p < 0.05 Z-score: 2.1822	–	NS
Advanced	p < 0.05 Z-score: 1.7638	NS	–

had some TH variation, while 46 per cent produced TH categorically as [θ] in both tasks.

A series of Z-tests were conducted to determine whether there were differences in the existence of TH variation in the dataset based on gender, MOI or proficiency. There was a tendency for more males than females to have TH variation, though this was not significant. In addition, a greater percentage of EMI than CMI students had TH variation, though this was also not significant. Proficiency, however, was significant; the results of the statistical analyses for proficiency are shown in table 3.

The statistical analysis showed that significantly more participants with Advanced proficiency had categorical [θ] in contrast to participants who had Low Intermediate proficiency. Significantly more Low Intermediate and High Intermediate proficiency participants had TH variation than participants who had Advanced proficiency. This suggests that TH variation is a developmental phenomenon.

As noted above, 24 of the 44 participants had TH variation. A closer examination of the conversation versus read data was conducted for these 24 participants. Data were also analysed for differences in the syllable position of TH, to determine whether this had an impact on TH variation. For the 24 participants who had variable realizations of TH, there were different degrees of TH variation based on the task and syllable position. This is illustrated in table 4. Nine participants had TH variation in both syllable positions across both tasks. While two of the participants had TH variation only in onset position in the conversation data, none of the participants had TH variation only in coda position or only in the read data. As this demonstrates, TH variation in coda position may imply variation in onset position, but not vice versa. This requires further investigation. In addition, TH variation only occurred in more formal (read) tasks if participants also had it in more casual (conversation) speech.

Table 4. *Percentage of TH variation by participant, syllable position and task*

Parti-cipant	Gender	Profi-ciency	MOI	Onset conv. (%)	Onset read (%)	Coda conv. (%)	Coda read (%)
37	F	Low	CMI	100	38	100	28
46	F	Low	CMI	96	38	50	67
34	F	High	EMI	96	8	38	67
65	F	Adv	EMI	74	36	–	44
3	F	Low	CMI	65	31	64	22
56	M	Adv	EMI	64	69	33	44
7	M	Low	CMI	64	62	–	67
8	M	High	CMI	53	46	–	72
33	F	Adv	EMI	52	31	–	72
30	M	High	EMI	42	100	–	44
21	M	Adv	EMI	36	31	33	61
24	F	Adv	EMI	21	31	–	33
32	F	High	EMI	20	38	–	–
50	M	High	EMI	15	77	–	50
42	F	High	CMI	12	8	20	28
10	F	Adv	EMI	12	38	11	78
55	M	High	EMI	8	31	25	33
38	M	Adv	EMI	8	38	14	–
57	M	Adv	EMI	8	–	–	–
45	F	Low	CMI	7	–	–	–
52	F	Adv	EMI	5	46	–	33
4	F	High	CMI	4	–	17	–
9	M	Adv	CMI	3	15	–	44
66	F	Low	EMI	3	–	40	–
No.				24	20	12	18

As table 4 also demonstrates, most, though not all, participants who had TH variation in both syllable positions and/or task types also had higher TH variation percentages overall. In contrast, the participants who only had TH variation in onset position in the conversation data had low TH variation rates overall, between 3 and 8 per cent. There was also a wide range of percentages of TH variation, from 100 to 3 per cent, depending on the syllable position and task. Two of the three participants with the highest percentages of TH variation across both tasks and both syllable positions had Low Intermediate proficiency in English.

5.1 VARBRUL analysis of the data

A VARBRUL analysis was conducted to examine which linguistic and non-linguistic factors constrained TH variation. Only data from the 24 participants who had TH variation were included in this analysis. All tokens with voiceless TH were coded as having one of three realizations: [θ], [f] or [s]. The realization of TH as [f] and [s] was

Table 5. *Linguistic factors in the VARBRUL analysis*

Factors	Example
1. *Preceding phonological environment*	
Vowel	*a thing, both*
Pause	*… /things*
Obstruent	*that things*
Sonorant	*all things*
2. *Following phonological environment*	
Vowel	*both of, thing*
Pause	*both …*
Obstruent	*both dreams*
Sonorant	*three, both lights*
3. *Syllable position*	
Onset	*thing*
Coda	*both*
4. *Word position*	
Initial	*thing*
Medial	*something*
Final	*bath*
5. *Syllable stress*	
Stressed	*bath*
Unstressed	*something*
6. *Lexical category*	
Nominal	*thesis*
Verb	*thought*
Numeral	*third, three*
'Think/Thinking'	*think*
'Thing/Things'	*things*
Determiner	*both*
Pronoun	*something, anything*
7. *Preceding labial in the word*	
Present	*warmth, fourth*
Absent	*think, anything*

coded separately to examine whether different constraints operated on the realization of TH as [f] vs [s]. The tokens were coded for several factors based on previous research as well as a preliminary analysis of the data. These factors are presented in table 5.

The tokens were coded for both syllable position (onset vs coda) and word position (initial, medial and final), though some overlap between two factors was unavoidable (e.g. all initials were also onsets, and all finals were codas). Due to the large number of words that occurred only once or twice in the data set, frequency

of lexical items was not investigated in the VARBRUL analysis. Instead, following previous research, the tokens were coded for lexical category such as 'nominal' and 'verb'. Additionally, separate categories were created for the words *think/thinking* and *thing/things* because a preliminary analysis of the data established that these two words frequently underwent TH variation. A third category, 'numeral', was established to capture words such as *third* and *fourth* as a preliminary analysis had established that these types of words also underwent TH variation more frequently than other lexical items. Many of the words in the data set were pronouns (e.g. *something*, *anything*) or determiners (e.g. *both*) and therefore these two word categories were added into the analysis. Following Clark & Trousdale (2009), the current research examined whether the realization of TH as either [f] or [s] was more likely if there was a preceding labial (in this case [b], [m], [f], or [v]) in the same word.

In addition, the tokens were also coded for four non-linguistic factors: task type (conversation versus read data), gender (female or male), proficiency (Low Intermediate, High Intermediate, Advanced) and MOI (EMI or CMI). Although only proficiency was found to significantly affect whether a participant had TH variation in contrast to categorical [θ] use, all four non-linguistic factors were included in the VARBRUL analyses to test whether they affected the likelihood of TH realization as [f] or [s] for those who had TH variation. Table 6 presents the percentage of TH realizations across the different factors. In this table, percentages should be read across a given row. For example, for the factor group 'preceding phonological environment', 68 per cent of realizations of TH as [θ], 28 per cent as [f] and 5 per cent as [s] had a preceding vowel. For the final column 'Total', the numbers demonstrate the total percentage of all tokens that corresponded to a given factor. Overall, 58 per cent of the TH tokens had a preceding vowel.

As table 6 demonstrates, there were a total of 1,680 tokens available for analysis from the 24 participants who had TH variation. Of these, 67 per cent were realized as [θ], 29 per cent as [f] and 5 per cent as [s].

Several VARBRUL runs were conducted to find the best model fit for the data. The findings from each of the two VARBRUL analyses are presented in table 7. In each case, the realization of TH as [f] or as [s] was run against the realization of TH as [θ] (e.g. in the analysis of the realization of TH as [f], tokens with realization as [s] were ignored, whereas in the analysis of the realization of TH as [s], all tokens with [f] were ignored).

As table 7 demonstrates, several factors were not significant for the realization of TH as either [f] or [s]: gender, task style, educational background, stress and word position. These factors will therefore not be discussed further in this section. Some differences were found in how different factors impacted TH realization as [f] or [s], demonstrating that TH realization as these two variants is constrained by different factors.

For realization as [f], four factor groups were found to be significant: lexical category, following linguistic environment, syllable position and preceding labial. Lexical category, with a range of .538, appears to have the strongest impact on the realization of TH as [f]. TH tokens in the words *thing/things* (.750) and determiners

Table 6.   *TH realization percentages across different factors*

Factors	[θ]	[f]	[s]	Total
Preceding phonological environment				
Vowel	663	270	44	977
	68%	28%	5%	58%
Pause	147	75	7	229
	64%	33%	3%	14%
Obstruent	41	36	13	90
	46%	40%	14%	5%
Sonorant	266	103	15	384
	70%	27%	4%	23%
Following phonological environment				
Vowel	721	195	45	961
	75%	20%	5%	57%
Pause	296	155	13	464
	64%	33%	3%	28%
Obstruent	27	6	1	34
	80%	17%	3%	2%
Sonorant	73	128	20	221
	33%	58%	9%	13%
Syllable position				
Onset	742	322	56	1,120
	66%	29%	5%	68%
Coda	375	162	23	560
	68%	29%	4%	33%
Word position				
Initial	641	306	52	999
	64%	31%	5%	60%
Medial	134	16	5	155
	87%	10%	3%	9%
Final	342	162	22	526
	66%	31%	4%	31%
Syllable stress				
Stressed	1,001	469	75	1,545
	65%	30%	5%	92%
Unstressed	116	15	4	135
	86%	11%	3%	8%
Lexical category				
Nominal	445	192	25	662
	67%	29%	4%	39%
Verb	36	23	2	61
	59%	38%	3%	4%
Numeral	108	103	15	225
	48%	46%	7%	13%

Table 6. *Continued*

Factors	[θ]	[f]	[s]	Total
'Think'/'Thinking'	398	127	30	555
	72%	23%	5%	33%
'Thing'/'Things'	29	21	1	51
	57%	41%	2%	3%
Determiner	11	5	2	18
	61%	28%	11%	1%
Pronoun	91	13	4	108
	84%	12%	4%	6%
Preceding labial in the word				
Present	287	140	27	1,223
	63%	31%	6%	73%
Absent	829	342	52	454
	68%	28%	4%	27%
Task style				
Conversation	640	235	560	935
	68%	25%	6%	56%
Read	477	249	19	745
	65%	33%	3%	44%
Gender				
Male	438	174	44	656
	67%	27%	7%	39%
Female	679	310	35	1,024
	66%	30%	3%	61%
Proficiency				
Low Intermediate	186	102	3	291
	64%	35%	1%	17%
High Intermediate	395	147	15	557
	71%	26%	2%	33%
Advanced	536	235	61	832
	64%	28%	7%	50%
Educational background				
EMI	784	324	64	1,172
	67%	28%	6%	70%
CMI	333	160	13	508
	66%	31%	3%	30%
Total	1,117	484	79	1,680
	67%	29%	5%	

(.665) were more likely to be realized as [f] than *think/thinking* (.554), numerals (.554), nominals (.468) or verbs (.468). It was least likely to be realized as [f] in pronouns (.212). Following linguistic environment, with a range of .480, also had a strong effect

Table 7. *Results of VARBRUL analyses*

Factors	[f]	[s]
Preceding phonological environment		
Vowel	.518ns*	.473
Pause	.443ns	.473
Obstruent	.644ns	.710
Sonorant	.458ns	.496
		range: .237
Following phonological environment		
Vowel	.294	.677
Pause	.294	.187
Obstruent	.508	.385
Sonorant	.774	.619
	range: .480	*range: .490*
Syllable position		
Onset	.653	.475ns
Coda	.223	.550ns
	range: .430	
Word position		
Initial	.501ns	.476ns
Medial	.298ns	.388ns
Final	.562ns	.587ns
Syllable stress		
Stressed	.517ns	.513ns
Unstressed	.312ns	.384ns
Lexical category		
Nominal	.468	.506ns
Verb	.468	.334ns
Numeral	.554	.501ns
'Think'/'Thinking'	.554	.513ns
'Things'/'Thing'	.750	.243ns
Determiner	.665	.674ns
Pronoun	.212	.544ns
	range: .538	
Preceding labial in word		
Yes	.656	.774
No	.441	.372
	range .215	*range .402*
Task style		
Conversation	.510ns	.561ns
Read	.488ns	.415ns

Table 7. *Continued*

Factors	[f]	[s]
Gender		
Male	.482ns	.590ns
Female	.511ns	.439ns
Proficiency		
Low Intermediate	.578ns	.333
High Intermediate	.483ns	.333
Advanced	.483ns	.662
		range: .329
Educational background		
EMI	.488ns	.449ns
CMI	.526ns	.622ns
Statistics	X^2: 35.536	X^2: 35.037
	df = 8	df = 7
	p < 0.001	p < 0.001
	Input Probability: 0.280	Input Probability: 0.106

*ns = not significant

on TH realization as [f]. Specifically, realization of TH as [f] was more likely to occur when the TH was followed by a sonorant (e.g. as in *three* or *both leave*) (.774). It was less likely to occur when followed by an obstruent (.508) and least likely with a following vowel or pause (.294). In terms of syllable position, TH in an onset (.653) was more likely to be realized as [f] than TH in a coda (.223). Finally, a preceding labial in the same word favoured TH realization as [f] (.656) over absence of a preceding labial (.441).

For realization of TH as [s], following linguistic environment had the strongest effect, with a range of .490, followed by preceding labial in the same word, proficiency and then preceding linguistic environment. Specifically, a following vowel (.677) and sonorant (.619) were more likely to result in realization of TH as [s] than a following obstruent (.385) or pause (.187). A preceding labial in the same word favoured TH realization as [s] (.774) over absence of a preceding labial (.372). Participants with Advanced proficiency (.662) had more realizations of TH as [s] than either Low or High Intermediate participants. A preceding obstruent promoted realization as [s] (.710) in contrast to a preceding sonorant (.496), pause (.473), or vowel (.473).

In sum, several findings emerged from the VARBRUL analyses, which will be explored more below in the discussion of the lexical analysis of the data. Firstly, linguistic environment, and particularly a following sonorant and/or a preceding labial, favoured the realization of TH as either [f] or [s]. These were the only two factors that significantly affected both realizations. Lexical category and syllable position only had a significant impact on realization of TH as [f], and preceding linguistic environment as well as proficiency only impacted realization as [s].

5.2 *Lexical analysis of the data*

A lexical analysis of the data was conducted to provide further insight into the findings from the VARBRUL analysis. Table 8 presents the lexical items by the number of speakers who had each word in their data set (total N), and how many of these participants had categorical realization of the TH in each word as [θ], [f] or [s], or exhibited variation in their production. As with the VARBRUL analysis, only data from the 24 participants who had TH variation in their data set were included in the lexical analysis.

As table 8 demonstrates, a total of 68 different lexical items with TH were found in the data set, with 56 different lexical items in the conversation data and 12 in the read data. A closer examination of this data reveals that TH variation is largely lexically conditioned, with categorical or near-categorical TH variant usage for each speaker.

The lexical analysis provides further insight into the findings of the VARBRUL analyses. Firstly, the significant effect of a following sonorant is illustrated in the effect of a following /r/: for example, in the onset read data, the words with the most realization as [f] or [s] were *threaten* and *throat*, both of which have a following /r/ after the TH. Of the 24 participants, 15 pronounced the TH in *throat* categorically as [f], one as [s], and two had variation in their production. In terms of *threaten*, 16 pronounced the TH categorically as [f] and one as [s]. The onset conversation data further illustrate this pattern: while 21 of the 24 participants had *three* in their data set, only one participant categorically realized the TH in *three* as [θ], with eight pronouncing the TH categorically as [f], one categorically as [s], and 11 participants having variation in their production. The TH in the words *through* and *throughout*, while not appearing in many of the participants' conversation data sets, was also categorically realized as [f] by some participants (one out of three for *through* and one out of two for *throughout*).

The lexical analysis also provides insight into the VARBRUL finding that a preceding labial has a priming effect on the realization of TH as [f] or [s]. It is likely that the higher rates of TH-fronting on the word *something* is the result of priming from the preceding labial as it occurred after a preceding [m]. While only one participant had the word *smoothie* in their data set, the TH was realized categorically as [f] by this participant, possibly also due to the preceding [m]. TH-fronting also occurred for the word *physiotherapy*, which has a preceding [f] in the word. The same pattern can be found when the TH was in syllable coda position: TH variation occurred most often in *month*, *both*, *math*. All three words also have a labial ([b] or [m]) in a preceding position in the word. The word *both* was also a determiner, a category the VARBRUL analysis found favoured TH-fronting. It is possible that it was the preceding labial and not the lexical category that had an effect on TH-fronting for this word. In fact, a closer examination of the words in this category in the VARBRUL analysis indicates that *both* was the only determiner in the data set. The word *path*, which also has a preceding labial in the same word, also had some TH variation: one participant out of the three who had this word in their data set had categorical [f] for the TH, while one participant had TH variation. *Mouth* only appeared in the conversation data for one

Table 8. *TH-realization across different lexical items*

Words	No. of speakers	Categorical [θ]	Categorical [f]	Categorical [s]	Variation
Conversation onsets					
thing	7	3	4	–	–
things	15	4	4	–	7
think	24	10	3	–	11
thinking	7	5	1	1	–
thought	3	2	1	–	–
three	21	1	8	1	11
third	6	4	1	–	1
thirty	12	9	2	1	–
thirteen	2	1	1	–	–
throw	1	1	–	–	–
thick	1	1	–	–	–
Thursday	2	2	–	–	–
theatre	1	1	–	–	–
theory	2	2	–	–	–
theories	2	2	–	–	–
theme	6	6	–	–	–
through	3	2	1	–	–
throughout	2	1	1	–	–
thank	3	3	–	–	–
something	22	14	3	–	5
anything	7	7	–	–	–
nothing	7	5	2	–	–
everything	7	6	1	–	–
authority	2	2	–	–	–
physiotherapy	1	–	1	–	–
hypothesis	1	1	–	–	–
enthusiastic	1	1	–	–	–
enthusiasm	1	1	–	–	–
smoothie	1	–	1	–	–
ethics	1	1	–	–	–
pathology	1	1	–	–	–
Read onsets					
think	24	15	1	–	8
thanks	24	21	2	1	1
third	24	12	11	1	–
thought	24	20	3	–	–
throat	24	6	15	1	2
threaten	24	7	16	1	–
Conversation codas					
north	5	5	–	–	–
south	2	1	–	–	1
month	8	3	2	2	1
months	1	–	–	–	–
truth	2	–	2	–	–

Table 8. *Continued*

Words	No. of speakers	Categorical [θ]	Categorical [f]	Categorical [s]	Variation
path	3	2	1	–	1
both	9	6	2	1	0
death	1	1	–	–	–
math	3	–	–	1	2
health	2	2	–	–	–
worth	2	2	–	–	–
youth	1	1	–	–	–
teeth	1	1	–	–	–
mouth	1	–	–	1	–
nineteenth	1	1	–	–	–
birth	1	1	–	–	–
northeast	1	1	–	–	–
bathroom	1	–	–	1	–
earthworm	1	1	–	–	–
mathematical	1	1	–	–	–
mathematics	8	8	–	–	–
pathway	1	1	–	–	–
Catholic	2	2	–	–	–
methodology	2	2	–	–	–
method	1	1	–	–	–
Read codas					
mouth	24	6	11	1	6
month	24	20	1	–	3
breath	24	16	2	–	6
fourth	24	14	6	–	4
health	24	16	5	–	3
warmth	24	8	15	1	–

participant, who categorically produced the TH as [s]. In the read data, TH variation was the most common in *warmth* and *mouth.* For both *warmth* and *mouth*, a preceding [m] in the word may have had fostered realization of the TH as [f] or [s].

As noted above, the VARBRUL analysis found that TH was more likely to be realized as [f] in numerals than in nominals, verbs and pronouns. The lexical analysis also demonstrates that numerals, and particularly *third*, *thirty*, *thirteen*, had some degree of TH realization as [f]. Interestingly, these numerals were all derivatives of *three*, a word with one of the highest rates of TH realization as [f] or [s]. The VARBRUL analysis also found that *thing/things* often had realization of the TH as [f], which the lexical analysis further demonstrates. For *things*, only four of 15 participants categorically realized it as [θ], while four categorically realized it as [f] and seven had variation in realization of the TH. For *thing*, of the seven participants who had this word in their data set, seven had categorical realization of the TH as [f]. In the VARBRUL analysis, the words *think* and *thinking* were grouped into one lexical item, which was found to

favour realization as [f] more than nominals, verbs and pronouns. The lexical analysis indicates that realization of TH as [f] is favoured more in *think* than in *thinking*. *Think* appeared in all the 24 participants' data sets and was realized categorically as [f] by three and in variation by 11 participants, with fewer than half of the participants (10 out of the 24 participants) producing it categorically as [θ]. In contrast, the TH in *thinking* was realized as [θ] by five out of the seven participants, with only one participant producing it categorically as [f] and one as [s]. It is not clear why the TH in *thinking* appears to undergo TH-fronting less than the TH in *think*. It is possible that syllable length is a factor; although this factor was not investigated in the VARBRUL analysis due to the low number of polysyllabic tokens in the data set, the lexical analysis does indicate that only a few polysyllabic words have realization of the TH as [s] or [f]. Interestingly, the TH in the word *thought*, the past tense form of *think*, had categorical realization as [f] by one of the three participants who had this word in their data set.

In sum, based on both the VARBRUL and the lexical analysis of the data, it appears that TH realization as [f] or [s] is more likely under the following conditions:

1. a following /r/: *three*, *throat*, *threaten*, *throughout*, *through*
2. a preceding labial consonant in the same word: *something*, *warmth*, *mouth*, *both*
3. numerals that are derivatives of *three*: *thirty*, *third*, *thirteen*
4. *thing/think* and their derivatives

Table 9 compares the lexical patterns in the current data set with three previous studies of TH variation to determine whether there are differences or similarities in lexical patterns across varieties of English. Data from the current study are compared with data from previous research on HKE (Deterding *et al.* 2008), as well as Edinburgh and London (Schleef & Ramsammy 2013) and New Zealand (Wood 2003). These are the only studies to date that have provided a lexical analysis of TH-fronting. For ease of comparison, the numbers in previous studies have been converted to percentages. Note, the realization of TH as [s] is only shown for the current study as previous research on HKE has not found this variant in their data; while it has been found as a variant in research on Scottish English, the numbers/percentage of realization of TH as [f] vs [s] have not been included in those studies.

The cross-comparison of TH realization by studies confirms the patterns already noted above. Firstly, TH-fronting, as well as realization as [s], is prevalent in onset position with a following /r/ such as: *three*, *through*, *throughout*, *throat*, *threaten*. The word *three* has high rates of TH-fronting in the current data set as well as in both the London and Edinburgh data sets (Schleef & Ramsammy 2013). It was also documented in earlier research on HKE (Deterding *et al.* 2008). While Clark & Trousdale (2009) note that TH-fronting was disfavoured in this environment in their data from Scotland, they do state that words with a following /r/ often have realization of TH as [s] for the speakers in their study. This realization was also found in the current data set, though it was not as frequent as realization of TH as [f]. As TH-fronting appeared to be more frequent on words with a following /r/ in London, Edinburgh and New Zealand

Table 9. *A comparison of TH across studies (as percentages)*

Realization	The current study			HKE (Deterding, Wong & Kirkpatrick 2008)		Edinburgh (Schleef & Ramsammy 2013)		London (Schleef & Ramsammy 2013)		New Zealand English (Wood 2003)	
	[θ]	[f]	[s]	[θ]	[f]	[θ]	[f]	[θ]	[f]	[θ]	[f]
Conversation onset											
thing	59	41	–	100	–	69	31	50	50	74*	26
things	52	44	4	–	–	82	18	75	25	74*	26
think	71	23	6	72	28	98	2	69	31	70**	30
thinking	67	11	22	–	–	–	–	100	–	70**	30
thought	67	33	–	–	–	53	47	–	100	67	33
three	25	62	13	25	63 [t] 13	29	71	35	65	83	17
third	58	42	–	–	–	60	40	–	100	–	–
thirty	80	7	13	–	100	–	–	–	100	100	–
thirteen	33	67	–	–	100	100	–	67	33	–	–
throw	100	–	–	–	–	50	50	–	–	50	50
thick	100	–	–	–	–	100	–	–	–	–	–
thousand	100	–	–	–	–	40	60	–	–	100	–
Thursday	100	–	–	–	–	–	–	–	–	–	–
theatre	100	–	–	–	–	–	100	100	–	–	–
theory	100	–	–	–	–	100	–	–	–	–	–
theories	100	–	–	–	–	–	–	–	–	–	–
theme	100	–	–	80	20	–	–	–	–	–	–
through	60	40	–	–	–	80	20	50	50	69	31
throughout	67	33	–	–	–	–	–	50	50	–	–
thank	100	–	–	100	–	100	–	–	–	–	–
thesis	100	–	–	–	–	–	–	–	–	–	–
ethics	100	–	–	–	–	–	–	–	–	–	–
something	83	12	7	67	[t] 33	59	41	14	86	92	8
anything	100	–	–	–	–	64	36	67	33	71	29
nothing	82	18	–	–	–	100	–	56	44	50	50
everything	78	22	–	100	–	80	20	27	73	92	8
healthy	100	–	–	–	–	–	–	–	–	–	100
unhealthy	100	–	–	–	–	–	–	–	–	–	–
authority	100	––	–	–	–	50	50	–	–	–	–
physiotherapy	–	100	–	–	–	–	–	–	–	–	–
hypothesis	100	–	–	–	–	–	–	–	–	–	–
smoothie	–	100	–	–	–	–	–	–	–	–	–
enthusiastic	100	–	–	–	–	–	–	–	–	–	–
enthusiasm	100	–	–	–	–	–	–	100	–	–	–
Read onsets											
think	83	16	1	–	–	–	–	–	–	–	–
thanks	85	11	4	–	–	100	–	–	–	–	–
third	54	42	4	–	–	–	–	–	–	–	–
thought	83	13	4	–	–	–	–	–	–	–	–
throat	31	65	4	–	–	100	–	–	–	–	–

Table 9. *Continued*

Realization	The current study			HKE (Deterding, Wong & Kirkpatrick 2008)		Edinburgh (Schleef & Ramsammy 2013)		London (Schleef & Ramsammy 2013)		New Zealand English (Wood 2003)	
	[θ]	[f]	[s]	[θ]	[f]	[θ]	[f]	[θ]	[f]	[θ]	[f]
Conversation codas											
north	100	–	–	–	–	–	–	33	67	40	60
south	80	20	–	–	–	100	–	38	62	100	–
month	52	35	13	100	–	33	67	100	–	72	28
months	100	–	–	–	–	–	100	–	100	67	33
truth	–	100	–	–	–	–	–	–	–	–	–
path	50	50	–	–	–	–	–	–	–	100	–
both	61	33	6	–	100	50	50	80	20	83	17
death	100	–	–	–	–	–	–	–	–	50	50
math	82	–	18	–	–	–	–	–	–	–	–
health	100	–	–	–	–	100	–	–	–	–	–
worth	100	–	–	–	–	–	–	–	–	50	50
youth	100	–	–	–	100	100	–	–	–	–	100
mouth	–	–	100	–	–	–	–	–	–	–	–
nineteenth	100	–	–	–	–	–	–	–	–	–	–
birth	100	–	–	–	–	–	–	–	–	–	–
northeast	100	–	–	–	–	–	–	–	–	–	–
bathrooms	–	–	100	–	–	–	–	–	–	–	–
earthworm	100	–	–	–	–	–	–	–	–	–	–
mathematical	100	–	–	–	–	–	–	–	–	–	–
mathematics	100	–	–	–	–	100	–	100	–	–	–
pathway	100	–	–	–	–	–	–	–	–	–	–
Catholic	–	–	–	–	–	–	–	–	–	–	–
methodology	–	–	–	–	–	–	–	–	–	–	–
method	100	–	–	–	–	–	–	–	–	–	–
Read codas											
mouth	33	63	4	–	–	–	–	–	–	–	–
month	90	6	4	100	–	33	67	100	–	–	–
breath	81	19	–	–	–	–	–	–	–	–	–
fourth	61	36	3	–	–	17	83	–	100	100	–
health	69	31	–	–	–	–	–	–	–	–	–
warmth	33	63	4	–	–	–	–	–	–	–	–

*combined tallies; **combined tallies

English, as well as in HKE, it appears that a following /r/ may be a phonological trigger for TH-fronting and/or [s] realization.

Secondly, in the current study, TH-fronting was prevalent in *think/thinks* as well as in *thing/things*; it also occurred in *nothing*, *everything* and *something*, though not in *anything*. As discussed above, TH-fronting is disfavoured in words with the *thing*

or *think* lexemes for some speakers of Scottish English (Clark & Trousdale 2009) as the TH may be realized as [h] in these words. The data from Edinburgh (Schleef & Ramsammy 2013) confirm this: TH-fronting in *think* is rare though it does occur in *thing/things/something/everything/anything*. It is, however, much more pervasive in London (Schleef & Ramsammy 2013), where the [h] variant does not exist for TH in these words. TH-fronting also occurs in these words in New Zealand English (Wood 2003). This suggests that *thing* and *think* and words with these lexemes are frequently realized as another variant and not [θ] in some varieties of English. It is noteworthy that TH-fronting in words with the *thing* lexeme is most prevalent in London, particularly in *something* and *everything*, which are the words in which TH-fronting occurred in HKE. It may be that the preceding labial triggers TH-fronting in these words, in contrast to *nothing*, *anything*, and that this process gradually diffuses to other words with the *thing* lexeme where the TH is in word-medial position. Realization of the TH as [f] is also prevalent in the word *thought* in the current data set as well as the Edinburgh, London and New Zealand data sets, most likely because it is a past tense derivative of *think*.

In terms of the occurrences of TH-fronting in *third*, *thirteen* and *thirty*, this may not be surprising in HKE given that they are all derivatives of *three*, which has the highest percentage of TH-fronting and [s] realization in the current data set. It is quite interesting that while *three* is also typically fronted in London and Edinburgh, and to some extent in New Zealand English, TH-fronting is also prevalent in the derivatives of *three* (*third*, *thirty*, *thirteen*) in London, and not in Edinburgh or New Zealand, though it does happen to some extent in *third* in Edinburgh.

While TH-fronting was not as prevalent in syllable coda as syllable onset position in the current data set, it did occur in coda position in some words, particularly in *both*, which also had higher rates of TH-fronting for English in London, Edinburgh and New Zealand, as well as *math*. Similarly, the word *month* (and *months* in New Zealand English) also had TH-fronting in both HKE and New Zealand English, and some fronting in London and Edinburgh, though the overall number of tokens for these words in the London and Edinburgh data was small and therefore conclusions cannot be drawn without further study. It is also favoured in *fourth* in the Edinburgh and London (small sample) data sets as well as the current one. The current study also found a high rate of TH-fronting in *mouth*, and *warmth* in the read data set. It is possible that a preceding labial has a priming effect on the following TH realization in the same word, and that a similar process occurs in other varieties of English. As noted previously, Clark & Trousdale (2009) found that a preceding [f] had a priming effect in Scottish English. In HKE, it appears that a preceding labial may have a priming effect on the realization of TH, though this requires more research.

6   Discussion

The first two questions the study seeks to answer are how pervasive TH variation is in HKE and whether gender, proficiency and MOI constrain TH variation in HKE. In answer to the first question, a little over half (24 out of 44 participants, 54 per

cent) had some TH variation in their data set, either realization of TH as [f] or [s] or both, which is similar to previous findings (Hung 2000). The current study found there were significant differences in whether participants had TH variation or categorical use of [θ] based on proficiency in English, with participants with Advanced proficiency having more categorical use of [θ] than participants with Low Intermediate proficiency, and less TH variation than both Low and High Intermediate students. This suggests that TH variation in HKE is a developmental phenomenon, a stage in the acquisition of TH as [θ]. The finding from the VARBRUL analysis that realization of TH as [s] is more likely for participants at an Advanced level of proficiency than for those of Low or High Intermediate proficiency further suggests realization of TH as [f] may occur in the initial stages of acquisition of TH, followed by realization of TH as [s] at a later stage of acquisition for some learners of English in Hong Kong. Previous research (Lau & Wong 2002) found that participants who had lower proficiency had greater difficulty discerning the difference between [θ] and [f] on perception tasks than secondary year 6 students. Taken together with the findings from the current study, this does suggest that TH-fronting is a developmental phenomenon in HKE. Research on both L1 and L2 acquisition of English (see, for example, Nemser 1971; Wenk 1979) has also found that [f] is a common realization of TH in early stages of acquisition. As discussed in the literature review, the realization of TH as [f] by both L1 and L2 learners of English in early stages of acquisition is probably due to misperception effects because English [θ] and [f] are acoustically very similar, both being produced with weaker energy than other fricatives (Tabain 1998). This acoustic similarity has also been proposed as the genesis of the emergence of TH-fronting in the UK (Blevins 2004), a diachronic sound change which is diffusing across England and Scotland, probably due to social (gender and socioeconomic class) factors.

Interestingly, no other non-linguistic factors, including gender, MOI and task, were found to affect TH variation in HKE. While more males had TH variation than females and, conversely, more females had categorical use of [θ] for TH in the current study, gender differences were not significant in the current study. Neither was MOI or task type. This suggests that TH variation in HKE is a linguistic phenomenon, most likely related to the acquisition of TH, and constrained by linguistic factors, including lexical category and linguistic environment.

As both the VARBRUL and the lexical analyses demonstrate, it appears that there is some degree of lexical conditioning, based on both linguistic context (following /r/, preceding labial) and lexical category (*thing* and *think* and their derivatives, and numerals). These patterns also appear in other data sets, including both London and Edinburgh English as well as New Zealand English (Woods 2003; Clark & Trousdale 2009; Schleef & Ramsammy 2013), suggesting that similar linguistic constraints operate on TH variation across varieties of English although which realization TH takes may be variety-specific. For example, a following /r/ was found to favour realization of TH as [f] or [s] in HKE (and [t] for some speakers in HKE in Deterding *et al.* 2008), as [f] or [s] for some speakers of Scottish English (Clark & Trousdale 2009; Schleef & Ramsammy 2013), and [f] in English in London and New Zealand

(Wood 2003; Schleef & Ramsammy 2013). Similarly, *thing* and *think* and their derivatives were often realized as [f] in HKE as well as in London and New Zealand English (this study; Schleef and Ramsammy 2013) and [h] in Scottish English in some cases (Clark & Trousdale 2009; Schleef & Ramsammy 2013). The current study also found that a preceding labial had a priming effect on the realization of TH as [f] and [s], an expansion of research on the priming effect of a preceding [f] on TH-fronting in Scottish English (Clark & Trousdale 2009). Taken together, these findings suggest that patterns of TH variation in HKE are constrained by linguistic processes similar to those at work in other varieties of English. Unlike these other varieties of English, however, TH variation appears to be a developmental process in HKE and therefore is not influenced by non-linguistic constraints such as gender and task, as has been found for TH-fronting in the UK (Kerswill 2003; Clark & Trousdale 2009; Schleef & Ramsammy 2013; Stuart-Smith *et al.* 2013). It is also possible, as Deterding *et al.* (2008) note, that speakers of HKE follow some linguistic trends such as TH-fronting from Britain; this is not surprising given that Hong Kong was a British colony until 1997, and that British English still has prestige in Hong Kong.

Another finding from the current study is the emergence of [s] as a variant of TH. As the lexical and VARBRUL analyses show, few differences existed in the realization of TH as [f] versus [s]. As the VARBRUL analysis also found that realization of TH as [s] was more probable for Advanced than for Low or High Intermediate proficiency participants, it is likely that [f] and [s] are not in allophonic variation in HKE but rather emerge at different stages in the acquisition of TH. This of course raises the question of why [s] was found in the current data set when it had not been previously documented in research on HKE. It is unlikely that the current study had participants with a higher proficiency level (and thus at a later stage of TH acquisition) than previous research, given that participants in both the current and previous research have all been university students in Hong Kong. A more likely explanation for the emergence of [s] is the rising influence of Mandarin Chinese in Hong Kong. Since the handover of Hong Kong to Chinese rule in 1997, Mandarin Chinese has gained in importance in Hong Kong, in education and business. The Hong Kong Government also promotes the teaching of Mandarin Chinese in Hong Kong and many primary schools have been replacing Cantonese with Mandarin Chinese as the Chinese in CMI. In fact, a recent survey found that fewer than 40 per cent of primary schools in Hong Kong use Cantonese to teach Chinese (Cheng 2016). As noted previously, [s] is the common variant for TH for speakers of English from China and Taiwan (Rau *et al.* 2009). It is therefore possible that as speakers of English in Hong Kong gain higher levels of proficiency in Mandarin Chinese, features of Mandarin Chinese will emerge in HKE. This merits further investigation.

7 Conclusion

Rather than asking the question of why TH variation occurs in HKE, this article concludes by asking, why isn't it *more* prevalent in HKE? The percentages of TH

variation in the current data set are low overall, particularly in comparison with other varieties of English (Schleef & Ramsammy 2013). This is interesting since both language-internal as well as substratum influences from Cantonese and possibly Mandarin Chinese would appear to provide linguistic motivation for TH variation to occur in HKE. As noted above, it is also possible that HKE is influenced by different varieties of English with regards to TH-fronting. The answer most likely can be found in social forces propelling or inhibiting TH variation. In other varieties of English, particularly in the UK, TH variation, and particularly TH-fronting, appears to be becoming a marker of a social identification of 'street' or 'urban' amongst young people, primarily males, and as such is beginning to cross socioeconomic boundaries (Stuart-Smith *et al.* 2007; Levon & Fox 2014). This 'youth code' is probably why it is gaining in use in other varieties of English in the UK, including in northern England and Scotland.

While research (Hansen Edwards 2016) suggests that HKE is gaining some acceptance in Hong Kong, many speakers of English in Hong Kong may still prefer an exonormative accent such as General American or Standard Southern British English. As such, distinctive phonological features of HKE including realization of TH as [f] and [s] may be viewed as 'errors' rather than 'innovations' and as a marker of being 'uneducated', particularly for those for whom a General American or Standard Southern British English accent is preferable and has more prestige (Hansen Edwards 2016). While the current research examined how pervasive TH variation is in HKE and which linguistic (and non-linguistic) factors constrain the realization of TH in this variety of English, it is still not clear how language ideologies about English accents, and, particularly, distinctive features of HKE such as TH-fronting, impact use of these features. One finding of the current study is that TH variation appears to be a developmental phenomenon, since it was less likely to occur among students who had Advanced proficiency in English; it is possible that these Advanced learners sought opportunities to develop their English skills, including their English pronunciation, to appear more proficient in English and thus attain a higher score on the HKALE or HKDSE. This merits further research.

Author's address:

Department of English
3F Fung King Hey Building
The Chinese University of Hong Kong
Shatin, Hong Kong SAR
jhansen@cuhk.edu.hk

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APPENDIX

The boy who cried wolf

There once was a poor shepherd boy who used to watch his flocks in the fields next to a dark forest near the foot of a mountain. One hot afternoon, he thought up a good plan to get some company for himself and also have a little fun. Raising his fist in the air, he ran down to the village shouting 'Wolf, Wolf.' As soon as they heard him, the villagers all rushed from their homes, full of concern for his safety, and two of his cousins even stayed with him for a short while. This gave the boy so much pleasure that a few days later he tried exactly the same trick again, and once more he was successful. However, not long after, a wolf that had just escaped from the zoo was looking for a change from its usual diet of chicken and duck. So, overcoming its fear of being shot, it actually did come out from the forest and began to threaten the sheep. Racing down to the village, the boy of course cried out even louder than before. Unfortunately, as all the villagers were convinced that he was trying to fool them a third time, they told him, 'Go away and don't bother us again.' And so the wolf had a feast. (From Deterding 2006)

Accent inventory

When a student from another country comes to study in the United States, he has to find out for himself the answers to many questions . . . and he has many problems to think about. Where should he live? Would it be better if he looked for a private room off campus or if he stayed in a dormitory? Should he spend all of his time just studying? Shouldn't he try to take advantage of the many social and cultural activities which are offered? At first . . . it is not easy for him to be casual in dress, informal in manner, and confident in speech. Little by little he learns what kind of clothing is usually worn here to be casually dressed for classes. He also learns to choose the language and customs

that are appropriate for informal situations. Finally he begins to feel sure of himself. But let me tell you, my friend, this long awaited feeling doesn't develop suddenly, does it? All of this takes will power.

Word list: (each word was read three times, in the carrier sentence 'I say _____')
think
thanks
third
thought
throat
threaten
mouth
month
breath
fourth
health
warmth