TH-stopping and laryngeal contrasts in Malaysian English

Le Xuan Chan

National University of Singapore

1 Malaysian English

Malaysian English (MalE) is a non-standard variety of English spoken in Malaysia, which belongs in the outer circle in Kachru's (1990) model of World Englishes. As Malaysia is a multicultural and multilingual society, MalE is a contact language that uses English as the superstrate, with surrounding languages such as Malay, Chinese, and Tamil forming the substrates. As any other language variety, it possesses a set of grammatical rules that is systematic and generative. The "non-standard" label given to MalE, rather than diminishing it as lesser and unimportant, merely indicates that some of its grammatical rules differs and departs from more "standard" varieties of English such as standard American English or British Received Pronunciation (RP). One of the main features of MalE is its segmental phonology. A list of phonotactic alternations in MalE from previous literature (Baskaran 2008, Phoon et al. 2013) is provided in Table 1.

	Alternation	**Example**
i.	Shortening of long vowels	/fiːt/ realized as [fit] for '*feet'*
ii.	Lengthening of short vowels	/brekfəst/ realized as [brekfəːs] for *'breakfast'*
iii.	Lack of vowel reduction	/əˈɹaʊnd/ realized as [ˈəˈɹaʊn] for *'around'*
iv.	Reduction of diphthongs	/meɪł/ realized as [mel] for *'mail'*
v.	Final consonant cluster reduction	/ɛləfənt/ realized as [ɛləfən] for *'elephant'*
vi.	Devoicing of final voiced fricatives	/ɪz/ realized as [is] for *'is'*
vii.	Voicing of voiceless fricatives	/nais/ realized as [naiz] for *'nice'*
viii.	Avoidance of dental fricatives	/θɪs/ realized as [dis] for *'this'*
ix.	Deaspiration of initial stops	/pʰaɪk/ realized as /pak/ for *'park'*

Table 1: Phonotactic Alternations in MalE.

The focus of this paper is on the avoidance of initial dental fricatives in MalE, otherwise known as TH-stopping (Drummond 2018). Acoustically, TH-stopping refers to the fortition of interdental fricatives /θ/ and /ð/ to alveolar stops [t] and [d]. Replacement of the interdental fricatives is not uncommon across other varieties of English, such as Irish English (Hickey 2007), Liverpool English (Watson 2007, Honeybone 2004), Multicultural London English (Drummond 2018), and also Singapore English (Wee 2008, Kim 2018, Moorthy & Deterding 2000), which shares similarities with MalE.

* This project was funded by the Japan ICU Foundation grant. A big thank you to Fernando Rojas and Paul Hastings from JICUF, as well as Seunghun J. Lee, Tomoyuki Yoshida, and everyone else at the ICU Linguistics Lab for all their help. This project was also presented at New Ways of Analyzing Variation Asia-Pacific 7 (NWAV-AP7) at Chulalongkorn University, Bangkok. I would like to thank the members and audience of both AJL6 and NWAV-AP7 for their ideas and comments.

1.1 *Previous literature on TH-stopping in MalE* TH-stopping has been described as a defining feature of MalE phonology in descriptive accounts (Baskaran 2008a, 2008b, Hashim 2020), and these claims are evidenced by experimental studies such as Phoon et al. (2013), Yamaguchi & Pétursson (2012, 2016), and Hamzah et. al (2017). In its comprehensive report of MalE consonants across different ethnic groups in Malaysia, Phoon et al. (2013) reports that TH-stopping is a regular feature of MalE utilized across Malay, Chinese, and Indian MalE speakers. Hamzah et. al (2017) also reported the production of /θ/ as [t] by Chinese Malaysian speakers, though this substitution only occurred for 30% of /θ/ tokens in the study.

One of the main questions to ask in TH-stopping is whether the underlying fricatives /θ/ and /ð/ are neutralized with the alveolar stops /t/ and /d/ when TH-stopping occurs. In other words, are the fricatives /θ/ and /ð/ represented as separate phonemes from /t/ and /d/? If so, what acoustic cues exist to tease the two categories apart? Hung (1995) argues for Singapore English that the alternation of /θ/ to different sounds at the initial ([t]) and final position ([f]) allows it to be categorized as a separate phoneme from /t/, which does not undergo such alternations for different positions.

Thus far, the only study that provides any form of acoustic analysis of TH-stopping in MalE is seen in Yamaguchi & Pétursson (2012, 2016), which included TH-stopped /θ/ and /ð/ productions in its report of Voice Onset Time (VOT) of MalE voiceless stops. With regards to TH-stopping, the study found that the voicing contrast of /θ/ and /ð/ are neutralized, with both fricative segments realized as unaspirated stops [t]. Interestingly, speakers utilized VOT as a cue for distinguishing between the underlying fricatives /θ, ð/ and the underlying stop /t/. Where /θ, ð/ were realized as the same unaspirated stop [t] with short-lag VOT, /t/ was realized as the aspirated [tʰ] with long-lag VOT.

1.2 *Unanswered questions* There still remains, however, several unanswered questions with regards to TH-stopping in MalE. The first has to do with the frequency of usage by MalE speakers. Where Phoon et al. (2013) reports TH-stopping as a regular feature across all subvarieties of MalE, Hamzah et. al (2017) and Yamaguchi & Pétursson (2012, 2016) report that speakers tend to realize the underlying /θ/ faithfully as the fricative [θ].

The other discrepancy between Yamaguchi & Pétursson (2012, 2016) and Phoon et al. (2013) has to do with the neutralization of voicing between the voiceless /θ/ and the voiced /ð/. As mentioned, Yamaguchi and Pétursson (2012, 2016) claims that /θ/ and /ð/ are neutralized into the same unaspirated stop [t]. However, Phoon et al. (2013)'s account argues that /θ/ is replaced with [t] while /ð/ is replaced with [d], showing that the voicing contrast between the two segments are preserved even in TH-stopping.

The third issue is that Phoon et al. (2013) reports regular deaspiration of initial voiceless stops /p, t, k/ in MalE. This poses an issue for the argument of VOT as the distinguishing cue for /t/ and /θ/ in Yamaguchi and Pétursson (2012, 2016). In other words, if /θ/ is realized as the unaspirated [t], and /t/ is deaspirated to be [t] instead of [tʰ], do the two segments become neutralized?

The final issue has to do with complex onsets, i.e. consonant clusters. Specifically, how would TH-stopping and the observations of VOT in Yamaguchi and Pétursson (2012, 2016) apply for sequences such as /θr/ in 'three' or 'throw'? This issue has not been addressed so far in MalE. In Singapore English, Kim (2018) reports that /θ/ is substituted with [t] in simple onsets, but with the affricate [t͡ʃ] in complex onsets. A similar pattern is also seen in the underlying stop /t/, which undergoes palatalization to [t͡ʃ] in complex onsets. Crucially, if both /θ/ and /t/ undergo the same alternation to [t͡ʃ] in complex onsets, this suggests that the two segments behave as one same phoneme and have are allophonic, contrary to the VOT argument by Yamaguchi & Pétursson (2012, 2016).

1.3 *Style-shifting: A compounding factor* Yet another compounding factor when investigating speech sounds in MalE is social registers and style-shifting. In other words, MalE speakers may alter their speech to accommodate their interlocutors. Descriptive accounts such as Baskaran (2008) and Hashim (2020), and even Phoon et al. (2013) concur that style-shifting occurs in MalE, with Baskaran (2008) providing a distinction between the more standard acrolect and the more "Malaysian" mesolect:

> In Malaysia, the acrolect tends towards StdBrE …The mesolect is very much the Malaysian variety – the informal style used among Malaysians. Speakers often weave into and out of this mesolect, using an almost International English at one instance (perhaps when speaking to a superior or with a non-Malaysian) and then switching into the mesolectal MalE when speaking to a friend. (p. 281)

The interest of this paper is how TH-stopping interacts with such style-shifting between different registers in MalE. If TH-stopping is a mesolectal feature that only occurs within in-group speakers, we should expect /θ, ð/ to be realized faithfully in the acrolectal register when speaking with non-MalE speakers.

2 The present study

2.1 *Research questions* The research questions of this study are as follows:

1. Is TH-stopping a regular feature of MalE, and does speaking with a non-MalE interlocutor affect TH-stopping?
2. Are fricatives /θ, ð/ and stops /t, d/ neutralized in TH-stopping? If not, what acoustic cues distinguish between the two?
3. Are /θ/ and /ð/ neutralized in TH-stopping, as in Yamaguchi and Pétursson (2016) ?
4. How does TH-stopping affect complex onsets such as /θr/?

2.2 *Stimuli* On top of the dental fricatives /θ/ and /ð/, we also included the coronal stops /t/ and /d/ as constants. The voiceless segments /θ/ and /t/ were also then put into consonant clusters /θr/ and /tr/. This gives us a total of 6 target segment conditions: /θ/, /θr/, /ð/, /t/, /tr/, and /d/, which were all placed in the initial position. The list of stimuli for each target segment is listed in (1).

(1) Stimuli List

/θ/	/θiːf/	thief	/θr/	/θriː/	three
	/θaɪ/	thigh		/θroː/	throw
	/θaʊzənd/	thousand			
	/θərzdeɪ/	thursday			
/t/	/tiː/	tea	/tr/	/triː/	tree
	/taɪ/	tie		/treɪ/	tray
	/tiːθ/	teeth		/treɪn/	train
	/teɪbəl/	table			
/ð/	/ðɪz/	this	/d/	/dəz/	does
	/ðæt/	that		/dɔg/	dog
	/ðeɪ/	they		/dɔːr/	door
	/ðiːz/	these		/deɪ/	day
	/ðɛːr/	their		/deɪt/	date
				/deɪli/	daily

The near-minimal pairs in the stimuli are “thief” and “teeth”, “thigh” and “tie”, “three” and “tree”, and “they”, “day”, and “date”. With the exception of /ð/ tokens and “does”, all tokens were controlled to be nominal content words. As content words beginning with /ð/ are rare in English, functional words were used for /ð/.

2.3 *Methodology* To elicit spontaneous speech, participants were recorded performing “spot-the-difference” DiaPix (Van Engen et. al 2010) tasks with an experimenter, where participants were instructed to find a set number of differences between their picture sets and the experimenters’ by asking yes-no questions. The target stimuli listed in (1) were inserted as illustrations within these picture sets. To investigate the interlocutor effect, each participant performed the DiaPix tasks twice – first with a MalE-speaker experimenter, then with a non-MalE speaker after a one-week interval. Trials were conducted beforehand to ensure that the participants were familiar with the task. All speech data was recorded with a Tascam DR-100 MK-III recorder, set at 44.1 kHz with 16-bit depth, mono, attached to head-worn SHURE WH30 unidirectional microphone with an XLR connector.

2.4 *Participants* Speech data was recorded from three male and three female Chinese MalE speakers. Though two speakers were born and raised in Pahang state, all speakers currently reside in Kuala Lumpur, the capital city, and use MalE as their most proficient language. A brief summary of language background by speakers is provided in Table 2.

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
Languages spoken (in order of proficiency)	English Mandarin Malay Cantonese Japanese	English Mandarin Malay	English Mandarin Malay	English Malay Mandarin Cantonese French	English Mandarin Malay	English Mandarin Malay Cantonese German
Languages used by speaker at home (in order of frequency)	Mandarin English	English Mandarin	Mandarin English	Mandarin	Mandarin English	Mandarin Cantonese
Languages used in Primary Education	Mandarin English	Mandarin English	Mandarin	Mandarin English Malay	Mandarin English Malay	Mandarin English
Languages used in Secondary Education	English Mandarin Malay	English Mandarin Malay	Mandarin Malay English	English Malay	English Malay Mandarin	Mandarin English
Languages used in Tertiary Education	English Mandarin Malay	English	English Malay Mandarin	English	English	English Malay
Languages used in Workplace	English Malay Mandarin	English	Mandarin English	English Malay	English Malay Mandarin	English

Table 2: Language Background of Participants.

English was ranked by all speakers as their most proficient language, and is used with friends, colleagues, and family. At home, however, Mandarin is more frequently used (though English is also used), as caregivers mainly use Mandarin. In terms of education, all speakers began learning English at the preschool level, around the ages of 3-4. Mandarin, however, was the most frequently used language by all speakers during their primary education. In secondary and tertiary education, however, English was ranked as the most frequently used language. English was also ranked as the most frequently used language in the workplace.

The data shows that though Mandarin was the dominant language in the household and in primary education, early exposure to English as well as the linguistic environment in urban Kuala Lumpur resulted in English being the most dominant language for all speakers in later stages of their lives. As a result, all speakers are not only proficient users of English, but also speak it as their first language.

2.5 *Annotation and analysis* For analysis, the target segment of each elicited token was judged and categorized as either a stop, a fricative, or an affricate by the author using visual cues of the speech signal as well as auditory perception. The reference for visual cues to distinguish between stops, fricatives, and affricates are taken from Raphael (2021) and Zsiga (2012). The voice onset time (VOT) for stop realizations were measured from the duration between the burst release and the voicing onset of the following vowel using Praat (Boersma & Weenink 2022). These included the underlying voiceless and voiced stops /t/ and /d/, as well as the voiceless and voiced fricatives /θ/ and /ð/ that were produced as stops.

A linear mixed model analysis with VOT as the dependent variable was in R (R Core Team 2022) using the lmerTest package (Kuznetsova et al. 2017). Segments were inserted as the fixed effect, while speaker and word were included as random effects.

3 Results

3.1 *TH-stopping as a regular feature of MalE* The results show that TH-stopping was used regularly by all speakers, and this pattern did not differ between interlocutors. In other words, the fricatives /θ/ and /ð/ were readily substituted with stop realizations in almost all utterances. The results for /θ/ are in Table 3 and 4, while the results for /ð/ are in Tables 5 and 6.

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
fricative	1	0	5	0	0	0
stop	15	10	8	11	7	11

Table 3: Realizations of /θ/ in Task 1 (MalE interlocutor).

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
fricative	2	0	5	0	0	0
stop	8	8	3	11	12	11

Table 4: Realizations of /θ/ in Task 2 (non-MalE interlocutor).

Out of 68 elicited tokens in Task 1, 62 were realized as stops while only 6 were realized as fricatives. In the second task, 60 tokens of /θ/ were recorded, and 53 of these were realized as stops while only 7 were realized as fricatives.

Unsurprisingly, a similar pattern was also shown for the voiced fricative /ð/. Out of 157 tokens in Task 1, 146 were realized as stops and 11 were realized as fricatives. In Task 2, 136 of 143 tokens were realized as stops, with the remaining 7 tokens realized as fricatives.

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
fricative	0	0	4	0	1	6
stop	32	19	11	22	20	43

Table 5: Realizations of /ð/ in Task 1 (MalE interlocutor).

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
fricative	2	0	0	0	0	5
stop	19	19	23	28	19	28

Table 6: Realizations of /ð/ in Task 2 (non-MalE interlocutor).

Overall, the results show a clear preference for MalE speakers to produce both the voiceless dental fricative /θ/ and the voiced dental fricative /ð/ as stops rather than fricatives. The data from each individual speaker displays the same pattern as well, though an exception is seen for /θ/ by MAL004 in Task 2. Crucially, the lack of any difference between Task 1 and Task 2 for both segments demonstrate that TH-stopping is a regular feature of MalE that is preserved when conversing with non-MalE interlocutors.

3.2 *Three-way laryngeal contrast separating /t/, /θ/, and /d, ð/* The next question to answer is if and how MalE speakers distinguish between the underlying fricatives /θ, ð/ and the underlying stops /t, d/ when TH-stopping occurs. The results show that MalE speakers utilize a three-way laryngeal contrast to distinguish between the underlying voiceless stop /t/, the underlying voiceless fricative /θ/, and the voiced segments /d, ð/.

3.2.1 */t/ and /θ/* Comparing the voiceless segments /θ/ and /t/, the linear mixed-effects model analysis with speakers and words as random effects revealed that VOT was significantly different between the two segments ($t = 5.2$, $p < 0.0001$). Where /t/ was generally realized as [t] with long-lag VOT typical of English voiceless stops (Lotz et. al 1960, Lisker & Abramson 1964, 1967, Lisker 1972), /θ/ was realized as the unaspirated [t] with short-lag VOT. Examples are shown in Figure 1, while the VOT values for both segments are in Table 7.

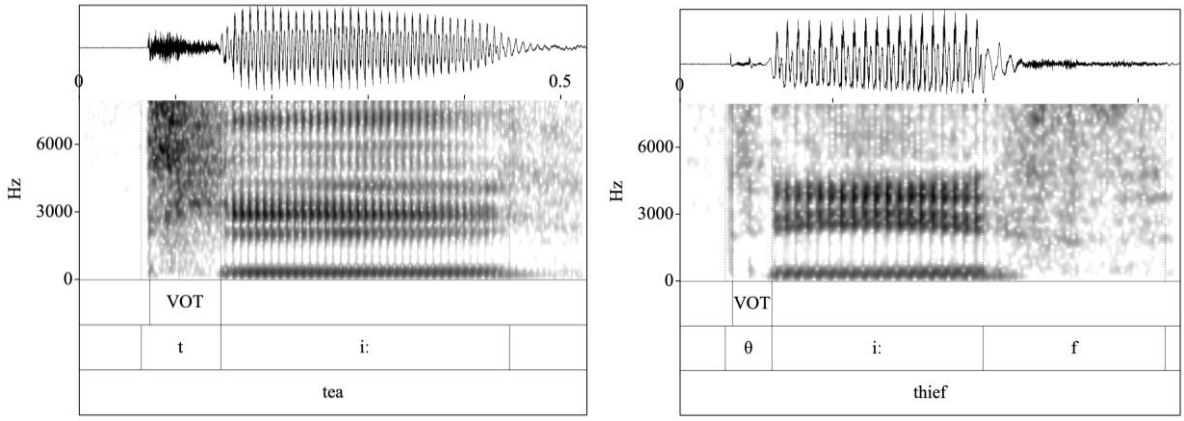

Figure 1: Realization of /t/ in /tiː/ 'tea' (left) and /θ/ in /θiːf/ 'thief'.

Segment	VOT (ms)					
	Min.	1st. Qu.	Median	Mean	3rd Qu.	Max.
/θ/	3.80	11.93	21.48	32.44	37.87	134.48
/t/	22.41	54.01	70.31	75.10	90.98	175.13

Table 7: VOT of /θ/ and /t/.

As shown, mean and median VOT for /t/ was 75.10 ms and 70.31 ms, with the majority of /t/ tokens realized with 54 – 91 ms (first to third quadrant) VOT. In contrast, mean and median VOT for /θ/ was 32.44 ms and 21.48 ms, with the majority of /θ/ tokens realized with 12 – 38 ms VOT. The clear distinction between these two segments indicates that when TH-stopping occurs, /t/ and /θ/ are not neutralized. VOT and aspiration appear to be the primary acoustic cue for distinguishing the phonemic contrast, and as such, these findings support the observations of VOT in Yamaguchi and Pétursson (2012, 2016).

3.2.2 *d/ and /ð/* Where the voiceless /θ/ and /t/ are distinguished by VOT, such distinction is notably absent for voiced segments. Both /d/ and /ð/ were realized as [d] with voicing during closure (negative VOT), and the same linear–mixed effects model with speaker and words are random effects revealed no significant differences in VOT between the two segments (t = –0.6, p = 0.931). Examples of both segments are shown in Figure 2, while VOT values are in Table 8.

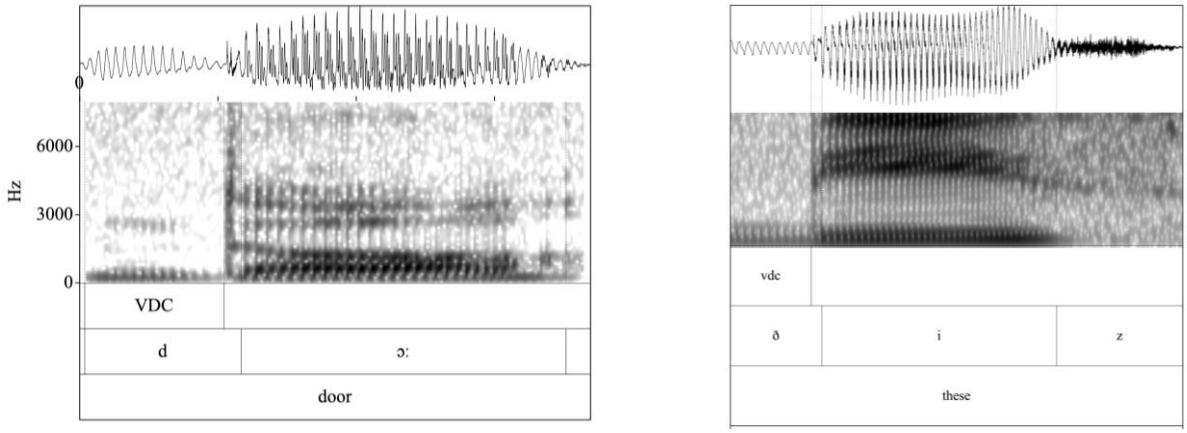

Figure 2: Realization of /d/ in /dɔː/ 'door' (left) and /ð/ in /ðiːz/ 'these' (right).

Segment	VOT (ms)					
	Min.	1st. Qu.	Median	Mean	3rd Qu.	Max.
/ð/	-154.97	-51.67	-22.76	-25.79	11.32	35.45
/d/	-191.22	-69.76	-35.85	-33.91	11.05	26.62

Table 8: VOT of /d/ and /ð/

As shown, both /d/ and /ð/ display similar VOT values, with the mean and median VOT of both segments at around –20 to –30 ms. Unlike their voiceless counterparts, the underlying voiced stop /d/ and fricative /ð/ do not utilize VOT as a distinguishing cue when /ð/ is TH-stopped. The current data, however, is insufficient to posit complete neutralization of /d/ and /ð/, as there may be other acoustic cues such as spectral information that may serve to tease the two apart.

Interestingly, the findings show that the voicing contrast between /θ/ and /ð/ are not neutralized in TH-stopping, as claimed by Yamaguchi and Pétursson (2012, 2016). Though both segments are unaspirated, Figure 2 shows that vocal fold vibration is present for the voiced /ð/ but absent for /θ/ in Figure 1.

3.3 *TH-stopping in complex onsets: /tr/ vs /θr/* With regards to complex onsets, almost all /t/ tokens in /tr/ sequences were realized as the palatal affricate [t͡ʃ], resulting in [t͡ʃr]. The pattern was the same across both Task 1 and Task 2, indicating that there was no interlocutor effect. This is shown in Tables 9 and 10..

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
affricate	8	12	5	8	11	9
stop	2	0	3	0	0	0

Table 9: Realizations of /tr/ in Task 1.

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
affricate	7	11	15	6	14	10
stop	1	0	0	0	0	0

Table 10: Realizations of /tr/ in Task 2.

For the underlying fricative /θ/, however, a bimodal distribution was observed where /θr/ was realized either as [t͡ʃr] with an affricate, or as [tr] with an unaspirated stop. Examples are provided in Figure 3, and the breakdown by speakers is in Tables 11 and 12 (stop realizations are in boldface).

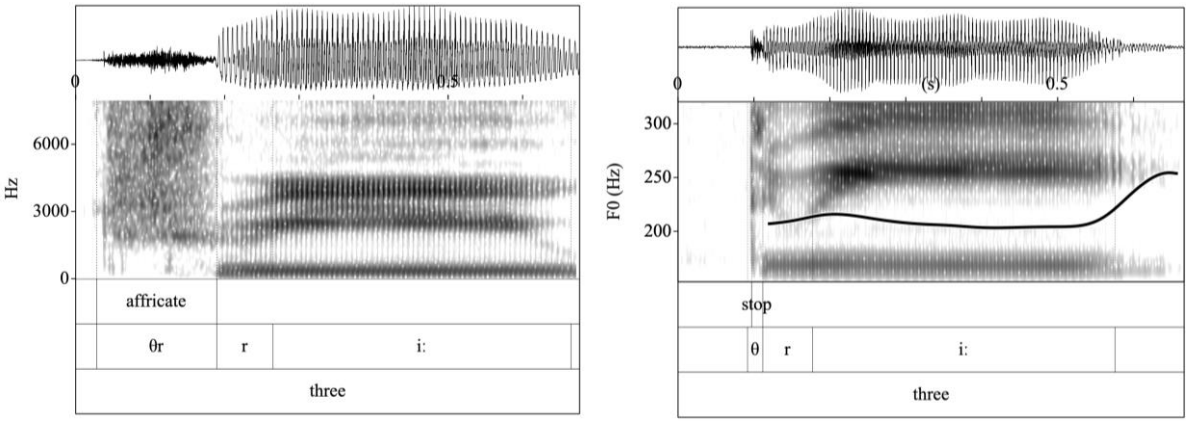

Figure 3: /θr/ realized as [t͡ʃr] (left) and as [tr] (right).

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
affricate	3	3	14	12	3	13
fricative	6	0	1	0	1	0
stop	**4**	**9**	0	0	**9**	0

Table 11: Realizations of /θr/ in Task 1.

	MAL002	MAL003	MAL004	MAL005	MAL006	MAL007
affricate	2	7	12	14	2	18
fricative	4	0	4	0	0	0
stop	**4**	0	0	0	**9**	0

Table 12: Realizations of /θr/ in Task 2.

As seen, the majority of /θr/ tokens were realized as [t͡ʃr], similar to the /tr/ tokens. When breaking the data down by speaker, however, only three out of six speakers – MAL004, 005, 007 – produced affricate realizations consistently, with all /θr/ tokens produced by the three speakers realized as [t͡ʃr]. An investigation into spectral means (Center of Gravity, Standard Deviation, Skewness, Kurtosis) and noise duration revealed no significant differences between the affricate realizations of /tr/ and /θr/ (shown in Table 13 below). This indicates that when the TH-stopped /θr/ is realized with an affricate as [t͡ʃr], it is seemingly neutralized into the same sound with /tr/.

Segment	COG (Hz)	SD (Hz)	Skewness	Kurtosis	Mean Noise Duration (ms)
/θr/	3844	2168	1.23	1.20	125.11
/tr/	3568	1982	1.47	2.49	127.28

Table 13: Comparison of affricate realizations of /θr/ and /tr/.

Speakers MAL002 and MAL006, however, show a preference towards the unaspirated stop realization [tr]. In the TH-stopped tokens (i.e. non-fricative realizations) of /θr/, MAL002 produced 8 of 13 tokens as [tr], while MAL006 produced 18 of 23 tokens as [tr]. A similar pattern was also observed for speaker MAL003 in Task 1, where 9 of 12 tokens were produced as [tr]. Crucially, these unaspirated stop realizations show that /θr/ is distinguished from /tr/ by manner of articulation, even when TH-stopping occurs. Hence, we see a bimodal distribution between speakers who realize the phonemic contrast between /tr/ and /θr/, and speakers who do not.

4 Discussion

4.1 *TH-stopping as a regular feature of MalE* The results from this study indicate that TH-stopping is a regular feature of MalE used in spontaneous speech. As such, the results concur with that of Phoon et. al (2013) and provide evidence for descriptive accounts in Baskaran (2008) and Hashim (2020). These results go against claims that TH-stopping usage is "sporadic" and that MalE speakers tend towards faithful realizations of /θ/ and /ð/ as fricatives (Yamaguchi & Pétursson 2012, 2016, Hamzah et. al 2017).

Interestingly, the lack of difference between Task 1 and Task 2 also indicate that TH-stopping is not a stigmatized feature of MalE that is avoided when addressing a non-MalE interlocutor. By the definition of the varying registers of MalE described by Baskaran (2008), this would suggest that TH-stopping belongs in both the standard acrolectal MalE and the "informal" mesolectal MalE. This further solidifies TH-stopping as a key phonotactic feature of MalE.

4.2 *Distinguishing /θ, ð/ from /t, d/* Since we have established TH-stopping as a regular feature of MalE, the question of whether the interdental fricatives /θ, ð/ and the alveolar stops /t, d/ are neutralized needs to be addressed. With regards to the voiceless segments, the answer is rather straightforward. The results clearly show

that while /t/ is consistently realized as the aspirated [tʰ] with long-lag VOT, the TH-stopped /θ/ is realized as the unaspirated [t] with short-lag VOT. Thus, VOT is the primary acoustic cue that distinguishes between /t/ and the TH-stopped /θ/, supporting the claims made in Yamaguchi and Pétursson (2012, 2016). Furthermore, the characterization of /t/ with long-lag VOT reiterates aspiration as an essential acoustic correlate for voiceless stops in English (Lotz et. al 1960, Lisker 1972). Interestingly, the deaspiration of initial voiceless stops /p, t, k/ as reported in Phoon et al. (2013) was notably absent in the findings of this study, suggesting a trend of increasing aspiration in younger educated MalE speakers as a sign of diachronic change in MalE phonology, similar to that described for Singapore English in Starr (2021).

With regards to the voiced segments, however, the results show that speakers do not utilize VOT to distinguish between the voiced stop /d/ and the TH-stopped voiced fricative /ð/. Both segments were realized voicing during closure, with near-identical values of negative VOT showing no differences in voicing duration. Based on the significance of durational contrasts between /θ/ and /t/, and the findings of Yamaguchi and Pétursson (2012, 2016), it is possible that /d/ and /ð/ are neutralized and treated as the same sound by MalE speakers. To provide more substance to this claim, however, would require further analysis into other acoustic correlates such as burst spectral qualities.

Additionally, these results also show that even with TH-stopping, the voicing contrast between /θ/ and /ð/ are not neutralized, as claimed in Yamaguchi and Pétursson (2012, 2016). The results clearly indicate vocal fold vibration as the primary voicing correlate for both /θ, ð/ and /t, d/, showing that voicing is still preserved during TH-stopping.

4.3 *Three-way laryngeal contrast in MalE* As such, MalE speakers demonstrate the ability to produce a three-way laryngeal contrast: aspirated, unaspirated, and voiced stops. This finding is interesting as Malay, English, and Mandarin – the languages spoken by all speakers in this study – utilize two-way laryngeal contrasts. Acoustically, Malay contrasts between voiced and voiceless unaspirated stops (Shahidi & Aman 2011), while Mandarin contrasts between aspirated and unaspirated voiceless stops (Sun & Profita 2020, Chen et. al 2007, Shimizu 2011). In other words, the acoustic correlate for Malay is voicing during closure, but aspiration for Mandarin. By borrowing Flege's (1995) Speech Learning Model of a "shared phonological space" where phonetic elements of a bilingual's L1 and L2 exist and influence each other mutually, we can argue that the the combination of laryngeal contrasts from Mandarin and Malay have contributed to this three-way laryngeal contrast in MalE phonology, which does not exist in standard varieties of English.

4.4 *TH-stopping in complex onsets* TH-stopping in complex onsets presents a more complex situation, with speakers benign divided into two camps: affricate [t͡ʃr] or the unaspirated stop [tr] realizations of /θr/. We may think of the discrepancy as being caused by a conflict between realizing the phonemic contrast between /t/ and /θ/ ([tr] realizations) and English phonotactic constraints ([t͡ʃr] realizations). [unaspirated alveolar stop + rhotic] sequences such as [tr] are not well-formed in English, and /tr/ and /dr/ are commonly palatalized into [t͡ʃr] and [d͡ʒr] due to the articulatory challenge of moving from an apical stop configuration to a postalveolar approximant configuration. Hence, MalE speakers who produce /θr/ as [t͡ʃr] seem to prioritize these phonotactic constraints over realizing the phonemic contrast between /θr/ and /tr/. Vice versa, we can think of the remaining speakers as giving priority to the phonemic contrast between /θr/ and /tr/: /θr/ is realized as [tr], and /tr/ is realized as [t͡ʃr]. Such speaker variation is not uncommon in the production of consonant clusters (McLeod et al. 2011). Crucially, the results indicate that TH-stopping is also prevalent even in complex onsets, with fricative realizations of /θr/ being dispreferred by most speakers.

5 Summary and future considerations

This study has attempted to address the issues in existing studies on dental fricatives in MalE, and found that 1) TH-stopping is a regular feature of MalE that is not stigmatized when speaking with an out-group interlocutor 2) MalE utilizes a three-way laryngeal contrast to distinguish between /t/, /θ/, and the voiced segments /d, ð/, and 3) the phonemic contrast between /t/ and /θ/ is maintained in complex onsets, but may be affected by phonotactic and articulatory constraints. A follow-up perception test would be useful in validating these results. Following the patterns found in this study, we should expect MalE speakers to judge unaspirated alveolar stops as /θ/ and aspirated alveolar stops as /t/. Furthermore, if MalE speakers consistently judge [t͡ʃr] as /tr/ and [tr] as /θr/, then we can conclude that the phonemic contrasts between the two segments are indeed maintained even in complex onsets, and that the affricate productions of /θr/ found in this study are motivated by articulatory constraints instead of phonological ones.

References

Baskaran, Loga. 2008. Malaysian English: Phonology. *Varieties of English* 4. 278-291.

Boersma, Paul & David Weenink. 2022. Praat: doing phonetics by computer [Computer program]. Version 6.2.08, retrieved 10 February 2022 from http://www.praat.org/

Chen, Li-Mei, Kuan-Yi Chao & Jui-Feng Peng. 2007. VOT productions of word-initial stops in Mandarin and English: A cross-language study. In K. H. Chen and B. Chen (eds.), *ROCLING 2007 Poster Papers*. 303-317.

Drummond, Rob. 2018. Maybe it's a grime [t] ing: th-stopping among urban British youth. *Language in Society* 47(2). 171-196.

Flege, James E. 1995. Second language speech learning: Theory, findings, and problems. In W. Strange (ed.), *Speech perception and linguistic experience: Issues in cross-language research*, 233-277. Balti more: York Press.

Hamzah, Mohd Hilmi., Aini Ahmad & Mohd Hasren Yusuf. 2017. A comparative study of pronunciation among Chinese learners of English from Malaysia and China: The case of voiceless dental fricatives /θ/ and alveolar liquids /r/. *Sains Humanika* 9(1). 1-9.

Hashim, Azirah. 2020. Malaysian English. In K. Bolton, W. Botha & A. Kirkpatrick (eds.), *The handbook of Asian Englishes*, 373-397. Hoboken, NJ: Wiley-Blackwell.

Hickey, Raymond. 2007. *Irish English: History and present-day forms*. Cambridge: Cambridge University Press.

Honeybone, Patrick. 2004. Influences in Liverpool English Koineisation [Presentation]. *Symposium on the Influence of the Languages of Ireland and Scotland on Linguistic Varieties in Northern England*. University of Aberdeen.

Hung, Tony T. 1995. Some aspects of the segmental phonology of Singapore English. *The English language in Singapore: Implications for teaching*. 29-41.

Kachru, Braj B. 1990. World Englishes and applied linguistics. *World Englishes* 9(1). 3-20.

Kim, Chonghyuck. 2018. Voiceless interdental fricative in Singapore English. *Studies in English Language and Literature* 44(4). 47-65.

Kuznetsova, Alexandra, Per B. Brockhoff, Rune H.B. Christensen. 2017. Lmer test package: Tests in linear mixed effects models. *Journal of Statistical Software* 82(13). 1-26.

Lisker, Leigh & Arthur S. Abramson. 1964. A cross-language study of voicing in initial stops: Acoustical measurements. *Word* 20(3). 384-422.

Lisker, Leigh & Arthur S. Abramson. 1967. Some effects of context on voice onset time in English stops. *Language and Speech* 10(1). 1-28.

Lisker, Leigh. 1972. Stop duration and voicing in English. In A. Valdman (ed.), *Papers in linguistics and phonetics to the memory of Pierre Delattre* (Janua Linguarum 54). 339-343. Hague: De Gruyter Mouton.

Lotz, John, Arthur S. Abramson, Louis J. Gerstman, Frances Ingemann & William J. Nemser. 1960. The perception of English stops by speakers of English, Spanish. Hungarian, and Thai: A tape-cutting experiment. *Language and Speech* 3(2). 71-77.

McLeod, Sharynne, Jan Van Doorn & Vicki A. Reed. 2001. Normal acquisition of consonant clusters. *American Journal of Speech-Language Pathology* 10(2). 99-110.

Moorthy, Shanti. M. & David Deterding. 2000. Three or tree? Dental fricatives in the speech of educated Singaporeans. In A. Brown, D. Deterding & E. L. Low (eds.), *The English language in Singapore: Research on pronunciation*, 76-83. Singapore: Singapore Association for Applied Linguistics.

Phoon, Hooi San, Anna C. Abdullah & Margaret Maclagan. 2013. The consonant realizations of Malay-, Chinese-and Indian-influenced Malaysian English. *Australian Journal of Linguistics* 33(1). 3-30.

R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Shahidi, A. H. & Rahim Aman. 2011. An acoustical study of English plosives in word initial position produced by Malays. *3L: Language, Linguistics, Literature*. 17(2).

Shimizu, Katsumasa. 2011. A study on VOT of initial stops in English produced by Korean, Thai and Chinese speakers as L2 learners. *International Phonetic Association (ICPhS XVII)*. 1818-1821.

Starr, Rebecca. L. 2021. 14 Changing language, changing character types. In L. Hall-Lew, E. Moore & R. Podesva (eds.), *Social meaning and linguistic variation: Theorizing the Third Wave*. 315-337. Cambridge: Cambridge University Press.

Strevens, Peter. 1960. Spectra of fricative noise in human speech. *Language and Speech* 3(1). 32-49.

Sun, Yue & Stefania Profita. 2020. Cross-linguistic Study on VOT of Chinese trilingual speakers. *Studies in Literature and Language* 20(1). 98-102.

Van Engen, Kristin J., Melissa Baese-Berk, Rachel E. Baker, Arim Choi, Midam Kim & Ann R. Bradlow. 2010. The Wildcat Corpus of native-and foreign-accented English: Communicative efficiency across conversational dyads with varying language alignment profiles. *Language and Speech* 53(4). 510-540.

Watson, Kevin. 2007. Liverpool English. *Journal of the International Phonetic Association* 37(3). 351-360.

Wee, Lionel. 2008. Singapore English: Phonology. *Varieties of English* 4. 259-277.

Yamaguchi, Toshiko, & Magnús Pétursson. 2012. Voiceless stop consonants in Malaysian English: Measuring the VOT values. *Asian Englishes* 15(2). 60-79.

Yamaguchi, Toshiko, & Magnús Pétursson. 2016. 3 The New [t] in Malaysian English. In T. Yamaguchi & D. Deterding (eds.), *English in Malaysia* (Brill's Studies in Language, Cognition and Culture 14), 45-64. Leiden: Brill.

Zsiga, Elizabeth C. 2012. *The sounds of language: An introduction to phonetics and phonology*. Chichester: John Wiley & Sons.