"WHEN LANGUAGES COLLIDE" A STUDY ON CROSS-LINGUISTIC PHONOLOGICAL INTERFERENCE IN MULTILINGUAL COMMUNITIES IN MALAYSIA

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Abstract

This study analyses the types of segmental and suprasegmental interference as well as the effect of executive functioning on the prevalence of phonological interference in Malaysian bilinguals and multilinguals. By focusing on four different language groups present in Malaysia, this study aims to identify the correlation between the inhibition of linguistic interference in the reading tasks and the inhibition of irrelevant stimuli. The segmental variants were examined by utilizing Weinreich (1953)'s framework while suprasegmental interference focused solely on stress placement and its role in polysyllabic words, compound words and at sentence-level. Variants produced in both sections were related to influence from the speakers' dominant language and Selinker's Interlanguage Theory (1972). Next, the role of executive functions in inhibitory control was investigated via the results of the Simon Task and Stroop Task to test the bilingual advantage hypothesis as well as whether better performance in executive function tasks translates to a lower susceptibility to phonological interference. The data of this study revealed that the Mandarin Chinese-dominant speakers produced the greatest number of variants overall while the English-dominant speakers and Tamil-dominant speakers showed the least variants in segmental interference and suprasegmental interference respectively. Despite significant anomalies in phonological variants produced and performance in Simon and Stroop Task, one notable correlation between low variant production and stronger performance in the Stroop Task was identified in English-dominant speakers, suggesting that language dominance plays a role in inhibition of interference and irrelevant stimuli.

Keywords*: segmental interference, suprasegmental interference, executive functioning, language dominance, inhibitory control, bilingual advantage hypothesis, interlanguage*

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List of Abbreviations

MalE: Malaysian English

L1: Dominant language

CA: Contrastive Analysis theory

EA: Error Analysis theory

IL: Interlanguage

TL: Target language

LPS: Latent psychological structures (LPS)

LEAP-Q: Language Experience and Proficiency Questionnaire

C: Consonant

V: Vowel

EF: Executive Functioning

IPA: International Phonetic Alphabet

"When Languages Collide" A Study on Cross-Linguistic Phonological Interference in Multilingual Communities in Malaysia

Chapter 1

Introduction

1.1 Background of the Study

1.1.1 Language Interference

Language interference, also known as language transfer or cross-linguistic influence, occurs when an individual is applying knowledge from one language to another (Odlin, 2005). As the linguist who pioneered the concept of interference, Weinreich (1957) found that the basis for interference to occur is language contact. Therefore, this phenomenon commonly occurs in bilinguals or multilinguals as the interference can occur in the primary or secondary language where the primary language causes interference and the secondary language suffers interference (Weinreich, 1957).

Linguistic interference can manifest in any situation wherein the individual does not have a native-level command of the language, and they tend to project the language rules from their primary language onto that particular language (Saidkodirovna, 2024). There are a few definitions of language interference according to linguists. The popular definition is by Weinreich (1957) in which interference is the cases of deviation from the norms of any linguistic systems that manifest in the speech of bilinguals as a result of knowing more languages or language contact. Haugen (1972) as cited in Saidkodirovna (2024) views interference as a linguistic network in which a certain linguistic unit may appear in two language systems at the same time. Dulay et.al. (1982) defines interference as an automatic transmission due to habits and overlaps between the first and

target languages while Mechkovskaya (2000) as cited in Saidkodirovna (2024) states that it is the errors in foreign language which occur in consciousness and speech of the individual due to the influence of the native language and is a psycholinguistic analogue of the mixing of languages in the supra-individual plane. A more modern take on the definition of interference by Kambarova (2022) is the transfer of linguistic features between languages in a bilingual or multilingual individual's speech repertoire whether from first to second, second to first or other relationships.

Furthermore, interference can occur consciously and unconsciously in which conscious interference occurs when non-native learners attempt to guess the production of speech or text of the language as they have no prior knowledge of the language or have forgotten its proper usage while unconscious interference occurs when the individual does not realize that the linguistic structure and rules of the languages are different (Saidkodirovna, 2024). Interference can also be classified into positive interference and negative interference. Positive interference refers to facilitation, in which some aspects of the languages learned by the individual are similar and may facilitate the learning or production of another language (Derakhshan & Karimi, 2015). Conversely, negative interference refers to when the individual makes errors in the target language due to the influence of the other languages in their verbal repertoire (Hayitboeva & Sattorova, 2024). This can be observed when the individual incorrectly applies the linguistic rules or structure of the languages, they previously learned onto the target language which can hinder their production as well as acquisition of speech or text in that language (Hayitboeva & Sattorova, 2024).

1.1.2 The study of Phonology

Etymologically, phonology is coined from the Greek word 'phono logy' in which 'phono' means sound and 'logy' means study (Nwabueze et. al., 2018). Therefore, phonology is associated with the organization of speech in a particular language. As different linguists have their own take

on the definition of phonology, Hawkins (2018) describes phonology as the study of sound patterns in language, and it is one of the main subfields of linguistics, as well as syntax, morphology and semantics; Idsardi and Monahan (2016) views it as the study of mental model for human speech from a neurological or cognitive neuroscience perspective; Kaye (2013) simply defines phonology as the study of the systems of linguistically meaningful sounds; and lastly, an earlier definition of phonology by Skandera and Burleigh (2006) is that it deals with the speaker's comprehension of a language's sound system and describes a language's phonological structure and patterns. According to Gries (2011), phonology encompasses the process where the distinctive sounds in a language must be identified, and rules must be set to outline the modifications these sounds will undergo when they interact differently with other sounds. Linguist David Crystal (2013) also notes in the Cambridge Encyclopedia of English that phonology aims "to discover the principles that govern the way sounds are organized in languages and explain the variations that occur". In a nutshell, phonology enables a speaker to systematically use sounds in a language to express meaning and understand the principles of regulating the use of sounds (Nwabueze et. al., 2018).

In phonology, there is the segmental aspect and suprasegmental aspect. According to Miller (1978), the speech signal carries information simultaneously about the phonemic segments of speech which are the consonant and vowels; and the suprasegmental features of speech which refer to the rhythm, intonation and more prosodic features. Segmental features can convey differences between words while in certain languages suprasegmental information can serve this function as well as convey different intentions of an utterance (Nwabueze et. al., 2018). Firstly, segments are categorized as individual sounds or phonemes in the form of consonants, vowels and diphthongs, and they form the building blocks of words in a language (Alfansyah et. al., 2020). Segments are concerned with the articulatory and acoustic properties and phonemes and as English is a language

with a large vowel inventory and diverse consonant clusters, there is a lot of room for segmental variation (Arini et. al., 2024). Words like “bit” and “beat” as well as “cat” and “bat” show that phonemic distinctions in individual sounds play an essential role in conveying meaning. However, Arini et. al. (2024) recognized that only relying on the presence of segmental contrasts is insufficient to portray the full spectrum of English phonology as the realization of these phonemic distinctions depend on the context, their interaction with surrounding phonemes, as well as their position within a word or phrase.

Consequently, this will make suprasegmental features indispensable in conveying the accurate meanings of utterances. Suprasegmental features cover a range of elements such as stress, intonation, and pitch that are used across these phonemic segments which can affect how sounds are perceived and understood in order to give different meanings to the same expressions or words (Alfansyah et. al. 2020). Homonyms, which are word pairs with identical pronunciation and spelling but can have different meanings (Merriam-Webster, n.d.), can be differentiated via stress patterns such as the noun-verb pair “record” (noun) and “record” (verb). As a result, the placement of primary stress can alter the meaning of these words which showcases the functions of suprasegmental features in lexical disambiguation (Arini et. al., 2024). On the other hand, another suprasegmental feature is intonation which does not change the lexical meaning of items but is responsible for part of the meaning of the whole utterance as certain changes in intonation can indicate change in the function of the utterance such as a statement or a question (Lehiste & Lass, 1976). Overall, segmental features and suprasegmental features are different by the fact that suprasegmental features are observed from a comparison of items in sequence while segmental features are identified by inspecting the segment itself. For example, a rounded vowel in a sequence of rounded vowels can be observed without needing to compare it to the preceding or

following vowels, but the degree of stress in a vowel cannot be observed without comparing it to other vowels that carry weaker or stronger degrees of stress.

1.1.3 Phonological Interference

This study aims to analyze interference in terms of phonology. As phonology refers to the study of distinctive sounds of a language to determine its phonemes, the variants of these phonemes and when they occur, suprasegmental features, stress patterns, and intonation (Deterding, 2024), phonological interference is the deviation in the pattern of speech sounds of a language and leans towards the abstract or mental aspect of sounds rather than the physical articulation of speech sounds (Alduais. 2015).

Brière (1966) states three main attributes of an individual's ability to learn phonological categories: "(1) the competing phonemic categories of the native language and target language systems; (2) the allophonic membership of these phonemic categories; (3) the distribution of the phonemic categories within their respective language systems". Brière (1966) also emphasized that the higher the degree of similarity between the speaker's native language and target language phonological systems, the easier it is for the speaker to learn the phonological categories of the target language while a lower degree of similarity might present some challenges in mastering the phonological categories of the target language. As such, the interactions between a speaker's native and target language play an important role in the prevalence of phonological interference.

As this study focuses on segmental interference and suprasegmental interference in speakers' phonological systems, segmental interference will be identified by variation in phonemes while suprasegmental interference will be observed through the use of stressed-timed and syllable-timed rhythm. Firstly, phonemic interference is defined by Weinreich (1953) as an occurrence

when a bilingual associates the phonemic system of the secondary system with the phonemic system of the primary language, which causes the production of phonemes of the secondary language to be based on the phonemic rules of the primary language. Secondly, suprasegmental interference in terms of rhythm indicates that the secondary language is influenced by the stress patterns of the primary language which will cause confusion and inaccuracies in conveying the actual meaning of the utterance (Alfansyah et. al. 2020).

Studies as done by Alfansyah et. al. (2020), Utami et. al. (2017), Mahmud (2017), and Suhery et. al. (2024) have identified phonological interference to be caused mainly by linguistic factors from the speaker's first language which can be explained by the existence of a hidden psychological structure in the brain of language learners that pronunciation occurs when a speaker or learner uses the second language as the brain is automatically activated as observed by Utami et. al. (2017). Alfansyah et. al. (2020) identified that phonological interference is mainly due to learners attempting to apply knowledge from their primary language onto the production of target language. Similarly, Gass and Selinker (2008) stated that the speech production of target language can be influenced when the phonological framework of their primary language is dominant and results in the replication of sounds similar to their primary language and slows down the acquisition of new phonemic patterns or prosodic features. Mahmud (2017) also recognizes that phonological interference manifests mainly due to the borrowing of systems from other languages as the speaker attempts to replicate sounds from one language but makes errors in adapting it to the target language. To sum it up, phonological interference typically manifests when speakers attempt to replicate the phonemic structure of their primary language during the production of speech in the target language as some sounds in the target language may be absent in the primary language (Astuty, 2022).

1.1.4 Executive function

As mentioned previously, language contact between the primary and target language is the main factor of phonological interference so it typically occurs in bilingual and multilingual individuals as they speak more than one language as opposed to monolinguals. Monolingualism is defined as the knowledge and usage of only one language (Raitskaya & Tikhonova, 2023), and this language is usually the first language the individual learns which is also known as the mother tongue (Ng, 1998).

However, the definition of bilingualism is more controversial. Early studies of bilingualism such as the linguist Leonard Bloomfield (as cited in Limberger & Buchweitz, 2014) defined bilingual individuals according to their proficiency in each language by stating that they were one person who had achieved monolingual-like proficiency in two languages. This suggested that the bilingual individual's proficiency in their second language increased at the expense of the first language (Baker, 2006) which was then argued by Grosjean (2009) that this monolingual perspective of bilingualism sets an impossible standard for bilingualism and instead defines bilinguals as individuals who use two and more languages or dialects in their everyday life, emphasizing on daily use instead of pronunciation skills (Grosjean, 2011). According to Limberger and Buchwitz (2014), Vildomec (1963) conducted the first in-depth psycholinguistic analysis of multilingual individuals and also debunked the early definition of bilingualism and stated that it was relatively rare for a person to be able to speak two or more languages equally well at the same time. While bilinguals speak two languages, multilinguals are defined to be proficient in three or more languages, with more focus on the L3 of the individual, regardless of whether it's the third, fourth or sixth language they have acquired (Limberger & Buchweitz, 2014).

Several studies such as done recently by Mohamed & Shaaban (2023), Yurtsever et. al. (2023), Filippi et. al. (2022) and Poulin-Dubois et al. (2011) have indicated that multilingualism and the acquisition of languages in both social and educational settings are extremely valuable as it is proven to provide cognitive benefits. Bilingual and multilingual individuals have often been shown to have cognitive advantages over monolinguals that are associated to executive functions such as working memory, inhibition, cognitive flexibility, task switching and more (Bialystok, 2017). According to Diamond (2013), executive functions refer to a range of higher-level cognitive processes that enable people to self-regulate, make decisions and carry out tasks. Similarly, Hughes and Graham (2005)'s take on executive function is a complex cognitive construct where a set of processes relay controlled, goal-oriented responses to navigate difficult situations.

Executive functioning is essential for cognitive processes such as the suppression of unnecessary or distracting information while maintaining focus on one source of important information which can be seen in suppressing phonological interference (Limberger & Buchweitz, 2014). With better executive functioning, bilinguals and multilinguals both tend to have an increased ability to understand and manipulate language, but when they are using one language, the other languages are typically present simultaneously (Zidan, 2024). This internal linguistic competition may result in slower pronunciations, phonetical deviations, increased tip-of-the-tongue states and other discrepancies among bilingual and multilingual speakers compared to their monolingual peers (Zidan, 2024) which may make them more susceptible to interlingual interference (Ng, 1998). Consequently, this study aims to investigate whether advantages in executive functioning leads to an increase in interference inhibition between multilinguals and bilinguals, instead of monolinguals.

1.2 Statement of Problem

There have been a few statements of problems for this study which are a lack of variation in studies of multilingual communities, shortcomings of phonemic interference models, and Mixed findings regarding cognitive advantages in bilinguals and multilinguals.

Firstly, there is an obvious lack of variation in studies of multilingual communities in terms of phonological interference. Despite multilingualism being a prominent characteristic in many communities, Franceschini (2011) notes that this phenomenon has only been recognized in linguistics for only around three decades. There is a lack of research involving multilingual groups and different varieties of language combination as there has been little work regarding how individual linguistic experiences impact an individual's susceptibility to cross-linguistic interference (Olsen & Seo, 2024). As Malaysians provide a wide variety of samples due to the different language combinations that Malaysians are proficient in, there is little academic investigations regarding the manifestation of phonetical and phonological interference in the Malaysian context.

Furthermore, there has recently been several studies focusing on specific populations such as in Indonesia (Mahfiroh & Sarage, 2022; Astuty, 2022; Utami et. al., 2017; Alfansyah, 2023; Riswanto et. al., 2021; Ahdiani, 2019). This may limit the applicability of findings from these studies to broader contexts as the samples chosen are niche and typically do not consider cross-cultural differences and other social factors. This specificity may hinder the process of developing more generalized theories or frameworks that can be applied to a larger variety of bilingual and multilingual setting as social factors can influence the direction and degree of linguistic interference. Moreover, recent studies such as done by Alfansyah et. al. (2023) and Ahdiani (2019) have shown that there are actually more factors causing interference such as cultural background,

use of the language in society, and foreign language aptitude instead of just influence of the primary language, which makes it important to study the types of interference that manifests in a multilingual community such as Malaysia in which other factors may come into play as well. With the increasing amount of diverse linguistic societies, there is a need for more research on phonological interference in wider contexts, especially in non-Western contexts (Abdurahmanov, 2024).

Thus, this study provides more empirical data for a deeper understanding of phonological interference in multilingual communities where there are lesser-studied language pairs and other different factors that may bring about linguistic interference. This is crucial in developing language learning strategies or improving pronunciation as understanding how different communities or different language pairs may display different linguistic interferences can help learners to identify differences in their language systems and consciously prevent themselves from making these errors.

The second statement of problem is that there have been some shortcomings and criticism in the research models of phonemic interference such as the one this study uses, which is developed by Uriel Weinreich, one of the pioneers of the concept of interference.

Firstly, phonemic interference models predict the learning difficult for a particular sound in order to create categories of potential interference, but they are unable to account for the level of difficulty of a new sound for a language learner (Flege, 1979). For example, American English speakers have great difficulty pronouncing the /ŋ/ sound in Vietnamese due to it being non-existent in English word-initial positions, but they have relatively no problems pronouncing the fricative /x/ in Arabic despite it not being in the word-initial position of English as well (Briere, 1966). Furthermore, learning difficulties that are caused by differences in the sequence of segments in which the phonemes are placed in the two different languages are even harder to detect and to

categorize into a distinctive feature interpretation in phonemic models as language-specific phonotactic constraints rely on sequence of segments instead of the feature combinations that occur in a single segment (Flege, 1979). In a nutshell, if the phonemic models are unable to fully account for the level of difficulty of pronouncing new sounds for language learners, there may be certain areas of variations in pronunciation or phonological interference that they have yet to cover or fully explore. This issue poses a problem as failure to resolve it will result in certain errors in pronunciation going unidentified in language learners or foreign language speakers and might stay unidentified until it becomes a permanent feature of their speech which makes it difficult to correct.

Secondly, the next problem for phonemic interference models is the asymmetry of errors between different languages (Flege, 1979). This is because phonemic interference models are built on the fact that contrastive analysis predicts the learning difficulty between two languages and the models must predict learning problems for speakers of both languages (Weinreich, 1953). However, only speakers of one language tend to experience difficulty in some cases in which some phonemic models are inefficient in detecting learning difficulties and may even have redundant features and categories. For example, English and German are different in a way that English is characterized with contrast in voicing the end of words while German is not, and this contrast leads to German speakers have difficulties learning English but not for English speakers learning German (Moulton, 1962; as cited in Flege, 1979). Therefore, phonemic models can determine which sounds are most difficult to pronounce in which phonemic contexts in order to create specific models that can cater to different language combinations. Addressing this criticism will be essential in developing language learning strategies in terms on phonology as it will allow researchers to foresee potential variations that will occur and will be prepared to correct these variations or avoid them altogether.

Next, the third criticism on phonemic models is that they fail to account of the variability of the speakers' errors as there is a gradual nature in phonological learning. This criticism is made mainly based on second language learning in terms of phonology. Phonemic models based purely on languages' structural differences can only be used based on the languages they account for and not in a general sense as they do not predict the substitution of several sounds for a single phoneme in the target language or the production of sounds that do not exist in the speaker's speech repertoire (Flege, 1979). As such, phonemic interference models cannot be used to evaluate and categorize phonemic variations as they do not account for the process of continuous learning. For example, Dickerson (1975) studied the way Japanese speakers tend to substitute the English phoneme /z/ for /dz/, /s/ or /∅/ which indicates that they do not voice out the /z/ sound at all. She found that the number and type of these substitutions occur depending on the speaker's level of proficiency in English, phonetic context and speech style which argues convincingly that the range of variants or interference from native language produced is not random and may be caused by the process of language learning. This pattern of various substitutions suggest that the implementation of foreign speech sounds is due to gradual learning but in contrast, phonemic models assume that language learners produce separate categories of sounds according to phonemes in either the target or native language with no correlation to gradual learning whatsoever (Flege, 1979). Consequently, this shows that phonemic models greatly overlook the variety of learners' speech as they attempt to predict the phonology of the target language without accounting for the process of gradual learning. With the ultimate goal of second-language phonology being to understand the learner's way of organizing sound patterns of the target language, this criticism highlights the important methodological handicap in phonemic models. Addressing this issue is important as observing the evolution of error types and details of how learners' implement phonemic features can help to

provide a better understanding of the learners' phonological system and second language phonology which can lead to the development of specific ways to combat these variations and lead the learner on the right path of learning pronunciation.

It can be concluded that the criticisms highlighted are mainly due to the controversial, if not problematic Contrastive Analysis (CA) in which phonemic models used to compare and predict errors between two languages (James, 1990). Wardhaugh (1970) renders the CA 'weak' as it only requires the linguist's best linguistic knowledge available and explains interference based on reference between the two language systems. However, as it is indisputable that a learners' knowledge of their primary language will influence the way they learn and approach a second language, which is what CA bases its predictions of errors on, the influence of native language on secondary language pronunciation has never been seriously questioned (Kavanagh, 2007). To wrap this section up, it can be said that phonemic models are less successful as they fail to account for the wide range and variety of pronunciation errors possible in which this study aims to help resolve by providing new empirical data on a less studied linguistic environment.

Lastly, the third statement of problem is that there have been mixed findings regarding the cognitive advantages that are supposedly associated with multilingualism. Extensive research is done on bilinguals while there is little evidence regarding language interference in trilinguals as most research is based on third language acquisition instead (Bruin, 2023). It is also unknown how potential interference between non-native languages can impact language production (Tomoschuk et al., 2021). Despite there being existing research on the neural foundations of multilingualism, it is still essential to examine the comparison between multilingualism and bilingualism as there are some scholars who deem these two concepts as distinct while many still use the term bilingualism

and multilingualism interchangeably, which can cause confusion, especially when researching on the differences of cognitive flexibility in bilinguals and multilinguals (Zidan, 2024).

In terms of cognition, the cognitive advantages such as cognitive flexibility of bilinguals is already known (Alshewiter et. al., 2024). However, there is a significant lack of knowledge in the Malaysian context about the cognitive advantages between bilinguals and multilinguals. The concept that bilinguals have more cognitive advantages is widely used when compared to monolinguals but is less certain when compared to multilinguals as there is only an understanding of the basic mechanics connecting bilingualism to cognitive abilities (Alshewiter et. al., 2024). Moreover, most research involving bilingualism, and its cognitive advantages are centralized on children with very little studies focusing on adults (Chung-Fat-Yim et. al., 2023). Cognitive flexibility can vary across people, languages and cultures, in which it is little understood (Alshewiter et. al., 2024).

Furthermore, there have been mixed findings in past research which indicated which do not support the cognitive advantage theory in which multilingualism promotes and enhances cognitive functions related to language as well as other basic under-lying cognitive functions such as memory inhibition (Greve et. al., 2024). Some researchers stated that there are no cognitive advantages to bilingualism compared to monolingualism and sometimes even monolingual superiority, which would in turn translate to bilinguals being cognitively superior to multilinguals. This may be due to lack of controlled factors in past research. Firstly, the degree of language competence in the participants are too different such as in Gowan and Torrance's study (1965) where the bilingual group consisted of Brazilian immigrant students who had just moved to America and students who were already living in America for a long time which resulted in a vast difference in their proficiency of English.

Moreover, past research also fails to account for participants in cross-cultural as well as bicultural or multicultural settings (Kharkhurin, 2007) such as a study done by Torrance et. al. (1970) where the monolingual group was made up of Chinese speaking monolinguals and Malay speaking monolinguals from Singapore combined and a study done by Fleith et. al. (2010) where Brazilian immigrants were categorized as a monolingual group when their English proficiency was high enough to be put in an English-only classroom. Thus, these studies provided biased results on the effects of bilingualism on cognitive advantages. According to Kim and Runco (2022), only two types of studies regarding the cognitive flexibility in bilinguals were conducted in previous research which are comparisons between monolinguals and bilinguals, and examination of bilinguals using their language proficiency in which most studies were conducted with immigrants. As a result, this study aims to provide a definite result regarding the difference in cognitive advantages between bilinguals and multilinguals which will address the problem of mixed variety of findings regarding cognitive flexibility in bilinguals and monolinguals which may very well impact the studies on cognitive flexibility between multilinguals and bilinguals. This is important in understanding the ability of bilinguals and multilinguals in supressing interference in order to develop language learning strategies such as by encouraging improvement of certain cognitive executive functions to improve suppression of linguistic interference which in turn leads to higher proficiency in the target language.

1.3 Research Objectives

1. To identify the types of segmental interference present in different multilingual groups in Malaysia.

2. To investigate the types of suprasegmental interference present in different multilingual groups in Malaysia.
3. To analyze the effect of improved executive functioning on the prevalence of phonological interference.

1.4 Research Questions

1. What are the types of segmental interference present in different multilingual groups in Malaysia?
2. What are the types of suprasegmental interference present in different multilingual groups in Malaysia?
3. Does improved executive functioning affect the prevalence of phonological interference?

1.5 Significance of the Study

This study is significant as it can provide data on phonological interference in a wider context, facilitate language learning, determine the role of executive functions in suppressing interference between bilinguals and multilinguals as well as aid in the development of clinical interventions in speech therapy.

Firstly, this study is important as it provides more empirical data on the types of phonological interference that can manifest in a multilingual community in which the participants speak not only two but three or more languages and have different cultural backgrounds. Malaysia has a unique linguistic and cultural landscape as Malaysians commonly speak more than one language as they interact with people of different races on a daily basis. Most Malaysians are proficient in

English and Malay which are the main languages of interracial communication and medium of education while Mandarin Chinese is more commonly spoken by the Chinese and Tamil is generally spoken by the Indians. Malaysians often speak more than two languages, such as Malay, English, Tamil and Mandarin as the more popular languages as well as the dominant ones in education (Pillai, 2021), with the Malay language being recognized as the official national language (Azarisman Shah & Latif, 2021). In other words, interference is unavoidable due to frequent interlanguage contact, creating a suitable linguistic landscape to analyze phonological interference. As a result, there are different types and degrees of interference that can manifest in different bilingual or multilingual communities as different languages have different phonological structure and rules.

Furthermore, in complex multilingual cultures, language variety can have a significant effect on the interaction between different languages (Suhery et. al., 2024). Moreover, English is a phonetically inefficient language (Culpeper et. al., 2022), which would make analyses on interference of other languages when speaking English insightful as it would give insight on how the phonemic structure of different languages influences an individual's pronunciation of English words. Moreover, a wider dataset on phonological interference in terms of segmental and suprasegmental features can also contribute greatly to the field of speech synthesis and recognition as it can provide a model for automatic speech recognition (ASR) systems to accurately transcribe spoken language and account for phonemic and stress variations in Asian varieties of English (Arini et. al., 2024). Thus, this study not only will provide empirical data on a less-studied multilingual landscape but can also add to the data needed to improve phonological interference models as well as speech synthesis and recognition models.

Secondly, this study is crucial in enabling researchers to develop strategies that can make language learning in terms of pronunciation more effective and efficient for learners. When learning language, identifying segmental features accurately are important to ensure correct word pronunciation (Meng et. al., 2009) while developing an understanding of suprasegmental features can enable the learner to encode rich information structure in their utterances and locate emphasized words, phrase boundaries, speech acts such as statements or questions as well as the speakers' attitudes and emotions (Grice & Bauman, 2007).

As a result, identifying the manifestation of segmental and suprasegmental interference can enable researchers to create tailored pedagogies for language teaching, especially in second and third language acquisition. For example, the intuitive-imitative approach that bases phonological learning on learners' ability to listen and imitate the pronunciation of the target language based on listening to audio materials without detailed explanation (Arimilli et. al., 2016). This approach can benefit from the findings of this study by identifying the specific types of phonological interference that typically happens in Malaysian speakers with specific linguistic backgrounds and implement this knowledge by playing audios with words or utterances that they are known to have trouble pronouncing in order for the errors to surface earlier so that it can be corrected immediately. However, it is a common opinion that phonetical and phonological errors in foreign language learning are supposedly insignificant which may lead to language learners developing phonetical and phonological deviations in the speech of the non-native language (Saidkodirovna, 2024). Thus, teaching correct pronunciation of a foreign language is essential.

Teaching pronunciation of a foreign language in the beginning stages is particularly difficult as the learner needs to learn the phonetic structure of a new language system and develop their auditory-pronunciation abilities from the beginning which makes the learner susceptible to

interference from the languages in their verbal repertoire (Saidkodirovna, 2024). Therefore, interference or negative transfer in segmental and suprasegmental features can significantly affect the intelligibility and comprehensibility of the language learner's speech and intentions (Meng et. al., 2009) in which this study aims to contribute findings regarding the types of phonological interference present in Malaysian multilingual communities in order to better develop pedagogies and teaching methods to help language learners suppress this interference, especially in language learners whose phonological deviations have not been corrected despite speaking the language for a long time.

Thirdly, the significance of this study lies in acting as a stepping stone for more detailed psychological research in understanding the cognitive control mechanisms in multilingual and bilingual speakers and whether the specific advantages that stem from their knowledge of two or multiple languages can increase their efficiency in supressing interference from the other languages in their speech repertoires. This can help to enrich the studies of cognitive science by providing information as to how the brain process information, manages interference and adapts to change. Interference can be suppressed by the speaker's ability to inhibit the non-target language which indicates the role of cognitive control in the production of bilingual language. This points to the direction of researching the correlation of linguistic and cognitive factors in influencing interference (Abdurahmanov, 2024). According to Bialystok (2017), language use is considered the most intense, sustained and integrative human experience in which it is used not only for communication but also conceptualizing and interpreting ongoing experiences. It is sustained because it is the only human activity that is carried out in the proportion of waking and perhaps even non-waking time unlike other activities that have known cognitive benefits such as musical

performances, can only be carried out in a limited amount of time in a day while there is no limit to language use.

Furthermore, Friederici (2011) has found that using language extensively involves most of the brain, including the frontal, temporal, parietal lobes and even some posterior regions which supports the hypothesis of cognitive benefits of increased experience in language use potentially generalizing beyond language as the experiences of using increased language use such as in multilinguals where multiple languages are used, involves more than just language-specific processes. This would support existing frameworks of bilingualism that advocate for the fluidity and adaptability of linguistic repertoires (Abdurahmanov, 2024).

In the context of multilingualism, this study can contribute to understanding how multiple languages can affect human cognition as learning a third or fourth language has a different experience compared to learning a first or second language and tends to be an understudied area in language learning (Limberger & Buchweitz, 2014). This can be explained by the fact that third language learners have acquired more linguistic acquisition from the experience of learning their first and second languages compared to second language learners and usually have developed more learning strategies and increased metalinguistic awareness (Cenoz, 2003). According to Filippi et. al. (2022), the mechanisms that are involved in the connection between multilingualism and the added benefits in terms of executive function are still incomplete and need to be further investigated. This study hopes to give insight through its findings on the difference in cognitive abilities of multilinguals and bilinguals. By determining whether or not multilingualism promotes better suppression of interference, this study can help researchers to identify whether learning multiple languages can or cannot promote inhibition of interferences and lead to better acquisition and proficiency of a target language. This can lead to a study on the complex strategies employed

by multilingual and bilingual speakers to navigate their complex linguistic environments (Abdurahmanov, 2024). The findings will also test the neuroscientific evidence regarding the possibility of increased language experience being more advantageous in the context of inhibition of interference and can lead to more in-depth research on how the parts of the brain involved in inhibition are activated in the field on neuroscience. This can also apply in the field of translation on whether translators who are proficient in multiple languages at once will be more effective and more accurate compared to translators who specify in certain language pairs or not.

Lastly, this study will aid in the development of clinical interventions in which speech therapists can select specific treatment targets for multilingual or bilingual patients that are compatible with their cognitive abilities to enhance treatment by understanding the difference in executive functions between multilinguals and bilinguals. According to Kiss and Csépe (2024), there has been an increasing body of evidence in the field of aphasia research that people with aphasia commonly experience cognitive impairments in their executive functions such as in studies done by Schumacher et. al. (2019) and Marinelli et al. (2017). Thus, through identifying the advantages of learning multiple languages regarding executive functioning, it may serve as a preventative measure for aphasia.

Additionally, the interferences tests may also serve to identify apraxia of speech (AOS) which is a neurogenic speech disorder characterized by lengthened and disrupted co-articulatory transitions with prosody and stress errors as well as consonant and vowel distortions (Dodd et. al., 2024). In this study, acquired AOS can be identified through the participants who are adults as it typically occurs in adults and signifies damage to parts of the brain related to speaking and language production (National Institute on Deafness and Other Communication Disorders, 2016). It can be identified when the participant displays distorting sounds, inconsistent errors in speech,

groping for sounds, and making errors in tone, stress or rhythm (National Institute on Deafness and Other Communication Disorders, 2016). Therefore, this study can help to catch speech discrepancies in the participants which can be traced to speech disorders and enable them to seek out medical intervention.

1.6 Scope and Limitations of the Study

This study is limited to analyzing the presence of the different types of phonological interference in terms of segmental and suprasegmental features, specifically phonemic interference and rhythm-based interference only, in the Malaysian multilingual community. This study only focuses on the field of phonology and not phonetics because there is a lack of access to resources and materials such as the spectrogram which is needed to analyze phonetical interference. The types of phonological interference are also specified to phonemic interference and rhythm-based interference as there is a lack of time to further delve into other aspects of segmental and suprasegmental interference.

The participants of this study will also be limited to 25 participants aged 18 to 60. The number of participants is limited as there is insufficient time to conduct testing on a larger sample size. The age of participants is limited as individuals 18 and older will have already passed the Critical Period which ensures the brain plasticity at that period will not be a factor in suppressing interference or increasing cognitive flexibility. The maximum age for participants is 60 years old as old age is characterized with cognitive and neural decline which can cause deficit in language production as well as more discrepancies in speech (Rossi & Diaz, 2016). Participants will also be limited to those who are proficient in at least 2 of these languages: English, Malay, Mandarin

Chinese and Tamil, in which they are able to read, speak and comprehend speech in those particular languages on a daily basis. The languages that the participants are proficient will only be limited to the language itself and not varieties of the language such as dialects. This limitation serves as an attempt to accommodate a broader range of languages instead of accepting dialects as a separate language in a participant's repertoire because dialects are also considered to have the same features of linguistic structure as the language it is derived from (Britannica, n.d.). Next, the languages that the participants are proficient in will also have to be acquired during their Critical Period, preferably during the ages of 9 and below (Vanhove, 2013) as early multilinguals or bilinguals tend to have stronger executive functions which enables them to have better interference control as they have been doing it since childhood (Pelham & Abrams, 2013).

Thus, this study is limited to analyzing interference only in the field of phonology specifically phonemic interference in segmental phonology and rhythm-based interference in suprasegmental phonology. The sample size is also limited to only 20 participants who are proficient in certain languages as a larger sample size with more language varieties will require more time and manpower. The respondents are also limited in terms of their age group and level of language proficiency.

Chapter 2

Literature Review

2.1 Definition of Key Terms

2.1.1 English in Malaysia

In Malaysia, the variety of English spoken by Malaysians is known as Malaysian English (MalE). Features and functions of MalE as well as the segmental and suprasegmental features are notably different from colloquial English as it has been influenced by Malaysian's first language, which can be Malay, Mandarin Chinese, or Tamil as well as socio-cultural factors (Aslynn et. al., 2024).

Firstly, MalE is said to have a smaller vowel system as typically paired vowels usually lack vowel contrast and monophthongs tend to focus on length contrast between vowel pairs instead, such as the vowels in words like 'bit' and 'beat', 'cut' and 'cart', as well as 'pull' and 'pool' (Baskaran, 2005). MalE lacks a contrast in vowel quality in which there is a lack of difference in measurements of the first and second formant of the vowels such as in words like 'beg' and 'bag', 'cut' and 'cart', as well as 'caught' and 'cot', which makes them sound like homophones when they are not (Pillai, 2014). There is also the occurrence where some diphthongs are pronounced as monophthongs in MalE, such as words like 'boat', 'coat', and 'load' tend to be pronounced with the diphthong /o/, instead of the monophthong /əʊ/. Furthermore, some consonants are also pronounced differently in MalE such as voiceless and voiced fricatives (Aslynn et. al., 2024). For example, the voiced /th/ in words like 'the' or 'there' is often pronounced similar to /d/ while the voiceless /th/ in words like 'three' or 'author' is pronounced as dentalized /t/. (Yamaguchi, 2014). There is also an observed tendency to shift placement of stress to another syllable in MalE which can be from the penultimate syllable to the antepenultimate syllable such as shifting the stress of

‘spaGHEtti’ to ‘SPAghetti’, or vice versa such as shifting the stress from ‘Camera’ to ‘caMEra’ (Hasim & Tan, 2012).

Moreover, stress placement in MalE tends to be inconsistent as there are no significant differences between the first and second syllable of a word in terms of duration, amplitude, and pitch as opposed to the observed differences in these three acoustic correlates of stress in colloquial English (Pillai et. al., 2019). There is also the tendency in MalE to not reduce vowels in unstressed syllables (Aslynn et. al., 2024). In terms of intonation, MalE speakers tend to end ‘yes/no’ questions with rises to their tone and ‘wh-’ questions with falls or rises (Aslynn et. al., 2024).

In Malaysia, English language education is given great importance, and it is a mandatory subject in Malaysian educational institutions (Zakaria, et. al., 2024). According to Majid et. al. (2022), one of the policies in the Malaysian Education Development Plan (PPPM) 2013-2025 is the Policy of Enhancing the Malaysian Language and Strengthening the English Language (MBMMBI) which aims to equip students with fluent language skills not only in the Malaysian language but also English in order to prepare them for the global workforce and improve Malaysia’s economic competitiveness.

2.1.2 Segmental Interference

The concept of the phoneme dates back to the time when humans first decided on writing down languages instead of using a pictorial system (Jones, 1957). The phoneme is defined as the smallest unit of speech that distinguishes a word element from another, such as the phoneme /p/ in “tap” is different from the phoneme /b/ in “tab” (Britannica, n.d.). Kazanina et. al. (2018)’s definition of the phoneme is that it refers to discrete symbolic units like individual speech segments such as consonants or vowels and can be combined to form words. Phonemes have two properties

which are that they are segment-sized, meaning that they can be categorized into vowels and consonants (Astuty, 2022); and that they are abstract in a way that a single phoneme can have different acoustic realizations (Kazanina et. al., 2018). A group of segments will make up a phonological unit known as a syllable which generally will have a vowel nucleus releasing and arresting consonant (Domathoti, 2021).

Vowels and consonants are considered phonemes or small pieces called segments that make up a word. For example, the word ‘man’ is divided into three segments which are /m/, /æ/ and /n/ (Domathoti, 2021). Vowel and consonants are different in terms of their acoustic characteristics (Lee & Nusbaum, 1993). Vowels are characterized by more steady-state acoustic information (Fry et. al., 1962) while the characteristics of consonants are rapid changes in amplitude and fundamental frequency (Delattre et. al., 1955).

Firstly, vowels are sounds where air flows out of the mouth freely with no constrictions and the sound is relatively strong (Domathoti, 2021). There are twenty vowels in English (Lubis et. al., 2024) and the vowels can be described through adjustments of the tongue such as place where the tongue is raised and height of the tongue raised as well as shape of the lips in terms of whether it is rounded or unrounded (Domathoti, 2021). On the other hand, consonants are sounds that are heavily obstructed and a constriction is made to interfere with the flow of air out of the mouth to reduce the energy of the sound (Astuty, 2022). There are twenty-four consonants in English (Lubis et. al., 2024) and can be produced differently through place of articulation which is the place of oral obstruction, voiced or voiceless which refers to the state of the vocal cords, and manner of articulation which is based on the closure between the two articulators when oral obstruction occurs (Clark et. al., 2007). Furthermore, phonemes may have more than one variant,

also known as an allophone, which has the function of a single sound as well but differ slightly phonetically such as the /p/s in “pat” and “spat” (Britannica, n.d.).

This study categorizes segmental interference based on Uriel Weinreich’s model of phonemic interference (1953). His model places emphasis on the system of oppositions between phonemes as the cause of interference instead of feature differences (Flege, 1979). From a theoretical perspective, Weinreich argues that phonemes from two different languages can never be considered the same despite how phonetically similar they might be as the phonemes within a single phonological system of a language is governed by a set of structural relations with other sounds (Flege, 1979). The four types of phonemic interference introduced by Weinreich are underdifferentiation, overdifferentiation, reinterpretation of distinctions and sound substitution.

Firstly, underdifferentiation occurs when the distinctive sounds in the secondary language system that are perceived to be redundant in the primary language system (Weinreich, 1953). This is when distinct sounds in the secondary language are reused due to the absence of that particular sound in the primary language. An example of this can be when speakers view vowel length distinction as redundant in words like ‘sheep’ and shorten the vowel to become ‘ship’. Secondly, overdifferentiation happens when phonemic distinctions from the primary system are imposed on the secondary system where they are unnecessary (Weinreich, 1953). For example, in a study done by Liashenko (2024) on Ukrainian speakers, overdifferentiation occurred when they were pronouncing the word ‘term’ with an extra, unnecessary ‘r’. Thirdly, reinterpretation of distinctions is seen when phonemes of the secondary system are distinctive but viewed as redundant in the primary language system and(Weinreich, 1953). This is due to a misinterpretation of differences in the phonemes of two languages, causing the speaker to alter the pronunciation and in most cases, the meaning of the word is altered as well. For example, Riau Malay speakers tend to substitute

the sound /θ/ in the word ‘teeth’ for /t/, which resulted in the pronunciation of /tiːt/ instead of /tiːθ/ due to a lack of the /θ/ phoneme in Bahasa Melayu (Mahfiroh & Sarage, 2022). Fourthly, the substitution of sounds occurs when a sound in the secondary language is replaced with a similar sound in the primary language due to the phonemes being graphically presented in the same way but have different pronunciations in the two languages (Rumalutur et. al., 2021). There is a direct replacement of the sound in the secondary language for a similar sound in the primary language. For example, a study conducted by Mahfiroh and Sarage (2022) on Riau Malay students found that they pronounced the word ‘very’ as /ˈfɛri/ instead of /ˈvɛri/ as the /v/ sound does not exist in Bahasa Melayu which causes the students to substitute it with the most similar phoneme in Bahasa Melayu, which is /f/, causing substitution of sounds.

Despite there being a standard variety of English in Malaysia, which is Malaysian English, with known phonemic features, this study aims to identify the different types of phonological interference that may manifest in different ways or degrees during the speech of Malaysian multilinguals from different races and with different cultural backgrounds as interference from different native languages may manifest differently as well.

2.1.3 Suprasegmental Interference

Suprasegments, also known as prosody, refer to unique properties of the utterances that have more than one segment that are made up of individual consonants and vowels in which Abercrombie (1965) used the term ‘features of voice dynamics’. Suprasegmental also means ‘above the segment’ and they include variations in loudness, duration, pitch, accent, intonation, as well as the degree of energy or effort put into the articulation of each sound in which they make certain elements more prominent than others (Crystal, 1969). A characteristic of suprasegmental features is that they must be described in concern of others as it is the relative values of pitch or

the stress of a syllable that is significant (Domathoti, 2021). There is clear difference between segmental and suprasegmental features is that English consonants and vowels are phonemic while suprasegmentals are not (Lee & Nusbaum, 1993). Furthermore, suprasegmental interference may have significant effects on communication that is not the characteristic of segmental interference as it is suprasegmental features that carry affective information (Flege, 1979).

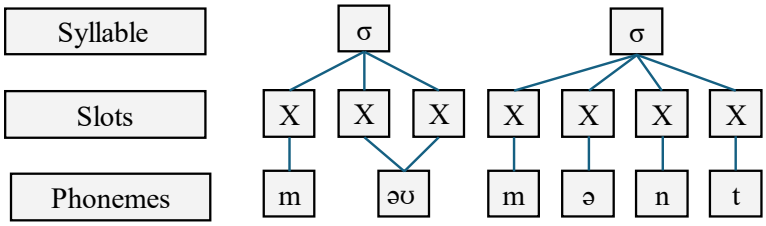
Despite segmental level interference being the more popular field of focus, recent studies have shown that suprasegmental features play an equally, if not more crucial role in the acquisition of phonological system of English as a second language (Wang, 2008). One of the most important suprasegmental features is stress as stress on different syllables can differentiate a word as a noun or a verb. However, it is the most complicated and least investigated one (Wang, 2008). Stress has a grammatical function and can be used to show contrastive emphasis in a sentence through higher intensity, longer segment duration and stronger or unreduced articulation in terms of spectral quality (Meng et. al., 2009). In biological terms, stress occurs due to an increase in the activity of the respiratory muscles which results in greater breath force (Domathoti, 2021). In English, there are stressed and unstressed syllables and it is often regarded as a stress-timed language in which the unstressed vowels are presented as 'blurred' (Ching, 2010). On the other hand, Asian languages tend to have different suprasegmental systems (Meng et. al., 2009). For example, Mandarin Chinese speakers place emphasis on their tone instead of stress as different tones give different meaning to a word on its own in contrast to English where stress gives the word a different meaning in a sentence (Ching, 2010). Moreover, stress in utterance can convey the information accurately in terms of marking the intended focus such as given information and new information or background information and foreground information. Conversely, misplacement of stress is more likely to affect intelligibility rather than mispronunciation of a phoneme such as by changing a full

vowel into a reduced one or vice versa which can cause miscommunication (Wang, 2008). According to Cutler and Clifton (1984), inaccurate placement of stress can 'precipitate false recognition, often in defiance of segmental evidence'.

On a syllable level, a word can be divided into number of syllables as well as the number of slots in the syllable (Meijer, 1994). The number of slots refer to the timing of phonemes which carry no information but merely used to indicate long vowels and long consonants which take up two slots, and short vowels and short consonants that take up one slot. Goldsmith (1990) assumes that there is some form of internal organization in a syllable unit, and it can be defined with the sequence of zero or more consonants, a vowel, and zero or more consonants in that order, in which these three subparts are called the onset, nucleus and the coda. The nucleus and coda are typically categorized into a rhyme. For example, the word 'moment' can be divided into two syllables that consist of the onset, nucleus and coda with seven slots altogether (Meijer, 1994).

Figure 1

Syllabic breakdown of the word 'moment'.



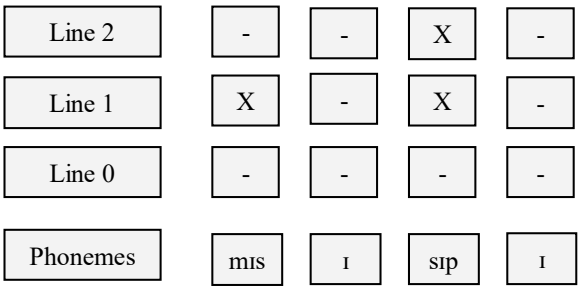
As shown in Figure 1, the first syllable is made of an onset with one consonant, a nucleus and no coda while the second syllable consists of an onset with one consonant, a nucleus and coda with two consonants. The stress is placed on the first syllable containing the diphthong /əʊ/. The

weight of the syllable depends on the sequence of vowel and consonant slots in the rhyme, which is the nucleus and coda (Meijer, 1994). In the Dutch language, Van der Hulst (2021) identified different syllabic patterns according to a weight scale in which extreme light syllables with minimal to zero stress are those with only a schwa in the rhyme while on the other hand, extreme heavy syllables typically have vowel-consonant-consonant (VCC) or vowel-vowel-consonant (VVC) rhymes. In English, the weight of syllables within a word can be used as a predictor for lexical stress in which the heavier syllable is the one to impose stress on (Meijer, 1994).

According to Meijer (1994), disyllabic words, which are words with two syllables, have either a prefinal or penultimate stress where the stress falls on the first syllable or a final stress where the stress falls on the last syllable; while longer multisyllabic words with more than two syllables contain main stress, secondary stress and even tertiary stress in which the latter is increasingly less prominent than the former. The lexical stress of a word can be illustrated based on its segmental components and characteristics of the syllables (van der Hulst & Smith, 1982) and this is done by using metrical grids or metrical trees (Liberman & Prince, 1977). In a metrical grid, each syllable has a placeholder in the grid at line 0 and a stressed syllable with have an indication on the foot level which is line 1 whilst the syllable with main stress will be indicated at line 2 which is the word level. For example, the word ‘Mississippi’ has four syllables in which the third syllable contains the main stress, the first syllable contains the secondary stress, while the second and fourth syllables remain unstressed (Meijer, 1994) (Figure 2).

Figure 2

Metrical grid indicating stress patterns of the word ‘Mississippi’.



Despite there being specific stress placement rules to describe the regularities of lexical stress for different languages such as in Dutch, where words ending with a vowel should have penultimate stress, words ending in a long vowel followed by a consonant should have final stress while words ending in a short vowel followed by a consonant should have penultimate or antepenultimate stress (Booiji, 1999). However, it is observed that despite the set rules for stress patterns, there are still a lot of exceptions and irregularities (Meijer, 1994). Therefore, it is still difficult to predict lexical stress to a fixed set of rules.

In English, stress is prevalent throughout phonological processes which makes discussing English phonology without the touching on stress impossible (Hsieh, 2021). However, the question is whether other languages rely on stress as much as English in communication which can affect its presence in the speech of multilinguals or bilinguals. As Malaysians tend to speak a mixture of Asian languages such as Malay, Tamil and Mandarin Chinese which have different suprasegmental systems compared to English, there may be difficulties in replicating the correct suprasegmental features due to the difference in language systems. According to Meng et. al. (2009), it has indeed been observed that most speakers of Asian Englishes have trouble with the appropriate placement of stress in words and utterance levels. Thus, this study will explore the phonological interference in terms of stress patterns in Malaysians.

2.1.4 Executive Function

According to Alshewiter et. al. (2024), the cognitive benefits of bilingualism and multilingualism have been the focus of a lot of research in recent years and it has been shown that the ability to speak more than one language is linked to improved executive functioning, in which bilinguals and multilinguals benefit from. In 1973, Karl Pribram coined the term 'executive function' and used it to describe implementation of flexible organizational programs as a function of the frontal cortex (Shaaban et. al., 2024).

Executive functioning is defined as a series of mental processes that require concentration and effort as well as help organize goal-directed actions such as reasoning, problem-solving and planning (Diamond, 2013). In the past, bilingualism and multilingualism were regarded as the same concept but now researchers have realized the different nature of speaking more than two languages and its impact on cognition (Catalano, 2018). Individuals that speak multiple languages have been shown to excel in activities and processes like resolving cognitive conflicts that require the use of executive functions in studies such as Bialystok and Viswanathan (2009). According to Alshewiter et. al. (2024), multilinguals tend to have more developed brains since they are required to navigate back on forth between them constantly and suppress interference from languages that are not in use which helps them to build better cognitive skills and improve executive function performance. It can also be argued that the act of learning several languages can strengthen one's mental fortitude as it provides some sort of mental workout (Bialystok, 2017).

However, there have been contradictory findings such as in Magiste (1985)'s research, she found that the more language systems an individual acquires, the longer their response times for different tasks that are used to identify interlingual interference which indicates that multilinguals show more interference than individuals who speak fewer languages. These findings are also

supported by Adesope et al. (2010)'s research who found that the cognitive advantages of speaking multiple languages may be different based on the specific executive function.

There are three primary executive functions proposed by Miyake et. al. (2000) which are shifting, updating and inhibition. Shifting refers to the ability to shift attention from one task to another; updating is tied to working memory and requires monitoring and interpreting incoming information in relevance to the current task and inhibition involves the suppression of irrelevant stimuli (Limberger & Buchweitz, 2014). Despite these three functions being separable and can contribute in different ways to the performance of an individual in complex tasks, they are still interrelated at a certain level. For example, the ability to shift from one set of rules to another, indicates the ability to update the set of rules and is interrelated to being able to inhibit the previous rule that has become irrelevant. In terms of neuropsychology, the prefrontal cortex function is the one controlling the maintaining of the coherence and temporal organization of goal directed actions and this is regarded as its most general characteristic (Fuster, 1988). Furthermore, the prefrontal cortex function also establishes the connection between the motor, perceptive and limbic regions while coordinating the processing activities in large regions of the central nervous system (Limberger & Buchwitz, 2014). Moreover, it has been known that executive functions begin to emerge in the first years of life, mature in late adolescence and decline with age from there (Hughes & Graham, 2005); thus, it starts as a single unit in childhood, develops into a sophisticated three-factor model in terms of attention shifting, cognitive flexibility in updating, and inhibition by the age of fifteen, and as the individual ages, their executive functions will decline, and processing speed will decrease as well (Limberger & Buchwitz, 2014).

As navigating between languages is a form of choosing an appropriate action to reach a goal, researchers have also investigated the function of inhibition and that it may be more well

developed in bilinguals (Limberger & Buchwitz, 2014). As inhibitory control is also described as the ability to suppress a dominant or automatic response, it supports the hypothesis that speaking two or more languages is related to improved executive functions (Miyake et. al., 2000). Researchers so far have assigned an attentional control mechanism to be the basis for how bilinguals or multilinguals navigate between multiple languages (Poarch & van Hell, 2012).

Firstly, Green (1998)'s study indicated that bilingual language production occurs due to inhibition of irrelevant language systems which resulted in the suppression of their activation which was supported by Meuter and Allport (1999)'s study which showed the phenomenon of asymmetrical switching between languages in low-proficient bilinguals and highly proficient bilinguals. This points in the direction of the necessity of stronger inhibitory control in suppressing interference from the primary language during usage of the secondary language in comparison to suppression of secondary language interference when using the primary language (Poarch & van Hell, 2012). As studies such as done by van Hell and Tanner (2012) have shown, when a bilingual or multilingual uses one language, the other languages are also active, indicating that cross-language activation is bidirectional in which highly-proficient bilinguals require continuous control of the two languages to suppress interference while bilinguals with low second language proficiency tend to require less effort in suppressing interference due to unidirectional cross-language activation in which only the primary language has effect on the secondary language. Consequently, this study requires participants to have learned their languages before the age of 9, which is before the Critical Period is supposed to have ended.

Despite there being a growing corpus of research regarding the cognitive benefits on executive functions in bilinguals and multilinguals, the basic mechanics tend to vary in terms of the individual, the languages they acquire and the cultural environment they live in, which

indicates that this relation between multilingualism and executive functioning requires deeper research as this connection is widely used by less understood (Bialystok, 2017)

2.2 Literature Review

2.2.1 Phonological Interference

2.2.1.1 Review of past studies in Malaysia

There is a limited body of research regarding phonological interference in Malaysia, but there are two significant studies on the variability in phonology in the different races in Malaysia. Firstly, a study done by Alias Abd Ghani (1995) investigated the phonological patterning according to stylistic differences in Malay, Chinese, and Indian students who were either majoring or minoring in English through verbal tasks such as minimal pairs reading, word list reading, dialogue reading and free conversation ranging from formal to casual speech styles. This study found that there is existence of phonological variation that is systemic in nature in which most of the students scored highest in the reading of minimal pairs test and lowest in free conversation. This suggested that their production of phonemes is related with the nature of the verbal task as well as their position in words. For example, the production of the phoneme /ð/ was correctly pronounced by half of the participants in the reading of minimal pairs task without regard for the position in the word but as they proceed to free conversation task, variations of the phoneme /ð/ appear such as /θ/, /t/, /d/, and /z/. Therefore, this study showed that the Malaysian speakers were able to produce the phonemes accurately in formal tasks but shifted to a more casual and comfortable way of speaking when they moved to casual tasks such as free conversation. Furthermore, in terms of ethnolinguistic backgrounds, it was revealed that participants with Malay backgrounds performed

the best in all the verbal tasks, followed by those from Chinese backgrounds and lastly those from Indian backgrounds.

Similarly, Utumber Singh, Yusoff and Malik (2014) conducted a study to determine the variants of phonological sounds among the different races in Malaysia and this study was modelled after the one done by Ghani (1995). The participants in this study were student teachers in Malaysia that have exposure to English and some majored in Teaching English as a Second Language (TESOL) while others majored in other courses. The distinct part of this study is that it included East Malaysian participants that were Bidayuh and Kayan and had different mother tongues from West Malaysians such as Dusun and Iban. The tests carry out were also minimal pair style, careful style word list style and reading style. This study showed that majority of the respondents who could not accurately pronounce the words were non-TESOL teachers. Majority of the Indians were able to pronounce the phoneme /ð/ sound correctly while the other ethnic groups were unable to do so, and it was assumed to be due to an absence of this sound in their native language systems. Only a small number of participants from these ethnic groups were able to pronounce this phoneme correctly and it was discovered that they were inclined to English language. It was also revealed that there were different variations of the phoneme /θ/ amongst the races on which Chinese participants pronounced it as /f/, Indian participants pronounced it as /d/ while Malay participant and those of other ethnicities tend to pronounce it as /t/. There was no observed pattern in variation across the different tasks.

Based on these studies regarding phonological variation in Malaysian speakers, we can conclude that there is indeed the presence of interference from the participants' native language in which this study aims to identify and classify.

2.2.1.2 Review of past studies in other countries

In other countries, there has been an existing dataset for phonological interference especially in Western languages and in Indonesia. Firstly, Aline Liashenko (2024) conducted a study regarding the inter-lingual phonic interference on a segmental level. The participants were native Ukrainian speakers and some of them were fluent Russian speakers as well while have a sufficient level of English for business communication. They had never lived in an English-speaking environment but had all experienced communicating with native English speakers. This study used perceptual analysis in which Liashenko had conversation with the participants for three to five minutes and noted down the errors in their responses and classified them according to Weinreich's model of phonemic interference. It was observed that the most common error was vowel substitution such as substituting the phoneme /ɛ/ to /ej/ and the phoneme /ɪ/ to /i/ and it had occurred almost 8 to 18 recorded times. However, the common error that occurred in all participants was underdifferentiation of phonemes by leaving consonant phonemes unaspirated. This can be explained due to the English language having many distinctive phonemes that do not exist in Ukrainian.

In Asian contexts, there has been a relatively rich variety of research in Indonesian speakers. A more recent study was conducted by Ani Dyah Astuty on the phonological interferences in Buginese students. The participants were all university students in which Buginese was their mother tongue and English was their foreign language. Astuty conducted a pronunciation exam of English consonants in terms of word-level and sentence-level in which the execution of tests was recorded and later examined to detect pronunciation errors. It was observed that the students had trouble pronouncing the labiodental fricative English consonants /f/ and /v/ as they replaced them with voiceless bilabial stop /p/, which is caused by influence from Buginese. They also were unable

to pronounce /θ/ and /ð/ and substituted them with /t/ or /d/. This can be explained by the nonexistence of the phonemes /θ/ and /ð/ in Buginese which caused the interference when pronouncing English sounds. Furthermore, it was found that the English palate-alveolar fricative sounds, /ʃ/ and /ʒ/ experienced interference from Buginese and were changed to voiceless dental fricative /s/, voiceless velar stop /g/ or voiced palatal affricatives /j/. However, Astuty argued that the mispronunciation of /ʒ/ to /g/ was due to lexical, not phonological, interference as the word 'genre' is supposed to be pronounced differently than in English.

We can conclude from these findings that interference from the participants' mother tongue can manifest in the production of English which is a second language or even foreign language.

2.2.2 Multilingualism and Executive Functions

Ellen Bialystok, Fergus M. Craik, Raymond M. Klein and Mythili Viswanathan (2004) conducted one of the earliest studies to identify whether bilingualism is associated with more effective controlled processing in adults. The participants were comprised of monolinguals and bilinguals who were also split into two different age groups of 30 to 54 years old and 60 to 88 years old. The participants were tested on their receptive vocabulary, nonverbal reasoning ability as well as inhibition abilities which was done via Simon Task. The study was conducted twice, the first time on Canadian English monolinguals and Tamil-English bilinguals while the second study was conducted with the same 2 groups of participants as well as another group of Cantonese English speakers in Hong Kong. In both these studies, it was found that the bilingual advantage persisted as the bilinguals consistently responded faster to both congruent and incongruent trials while producing a smaller Simon effect which indicated less disruption from irrelevant stimuli regardless of speed. Therefore, this study was able to prove that bilingualism did bring about positive advantages in terms of improving executive functions.

On the other hand, a study conducted by Rossana Kramer and Mailce Borges Mota (2015) was also regarding the effects of bilingualism on executive functioning. The participants were Brazilians aged from 18 to 84 years and consisted of early bilinguals who spoke Brazilian and Portuguese or Hunsrückisch, late bilinguals who spoke Brazilian and Portuguese or English, and monolinguals who spoke Brazilian or Portuguese. Similarly, the Simon Task was used to test inhibitory control while the Alpha Span Task assessed verbal working memory. Despite the similar method of testing, this study found that there were no statistically significant advantages for early bilinguals in reaction time based on the assessment in the Simon Task. The results showed that there was no obvious bilingual advantage among the bilinguals in this study compared to their monolingual counterparts. Therefore, the absence of retrieving consistent bilingual advantage results indicate that it is still unconfirmed regarding the precise conditions and circumstances in which bilingual advantage is found.

Based on these two studies with contradictory results, this study aims to resolve this inconsistency regarding the cognitive advantage of bilingualism and multilingualism. As we can see from these studies, bilinguals who are speakers of two languages are dealing with high levels of competition between the languages so it would make sense for multilinguals who speak more than two languages to navigate through even higher levels of competition, and thus the existence of cognitive advantages would be more prominent and obvious (Limberger & Buchwitz, 2014).

2.3 Theoretical Framework

2.3.1 Selinker's Interlanguage Theory (1972)

Before the Interlanguage theory was formulated, the Contrastive Analysis (CA) theory and Error Analysis (EA) theory were the prevalent frameworks used to identify variations or differences in an individual's production of speech in two languages (Al-khresheh, 2015).

The CA theory assumes that error and level of difficulty of learning new sounds are equal which is not the case since error is resulted from language product while language difficulty is more related to psycholinguistic concepts in which language learners may tend to make more errors in areas of low difficulty as they let their guard down due to the low perceived level of difficulty as compared to areas of high difficulty in which they are more careful as to not make any mistakes (Lennon, 2010). It also assumes that error is directly caused by first language interference without considering other factors such as cultural environments.

On the other hand, the EA theory is problematic in terms of identification of errors as well as classification of errors (Lennon, 2010). According to Hughes and Lascaratou (1982), it can be difficult to identify unambiguously errors in language as well as the distinction between 'errors' and 'mistakes' as correct and incorrect forms of a single target are prone to occur simultaneously and side-by-side. In terms of classifying these errors, it depends on the error being related to which field of linguistics such as phonology, morphology, syntax and more and is by no means a straightforward task (Lennon, 2010). Counting the exact number of errors also becomes a problem when the errors happen in the same phrase, or one error occurs in the same position that is already incorrect.

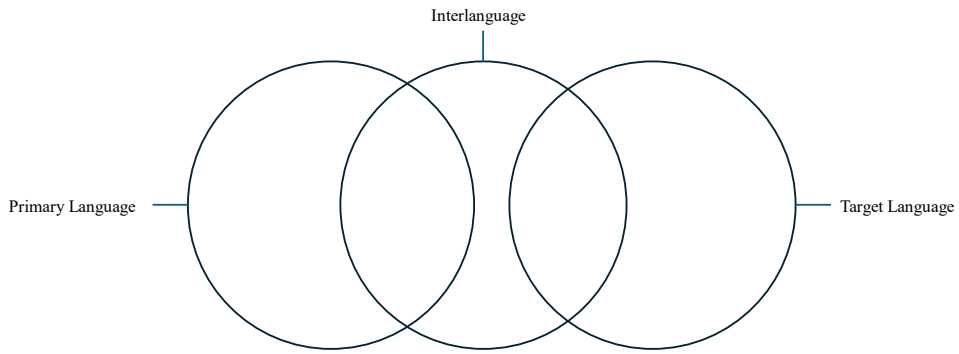
Despite having multiple criticisms, these two theories paved the way for an improved theory which is the Interlanguage (IL) theory that focuses on describing language learners' errors from its own perspective instead of solely due to the influence of native language (Al-khresheh, 2015).

Selinker's Interlanguage Theory (1972) introduces the existence of a separate linguistic system which resulted from the speaker's attempted production of a target language and argues that this separate linguistic system, known as the interlanguage (IL) should not be viewed through the lens of the foreign language or target language system, but instead treated as an individual language system with its own internal consistency (Al-khresheh, 2015). The IL is independent of both the target language and primary language while also gradually approaching the target language's system (Al-khresheh, 2015). In contrast to the CA and EA theory, IL is viewed as a transitional process between the target language and primary language while the former two are processes influenced by either the target language or primary language (Selinker, 1972).

Selinker (1972) built the IL theory on the EA approach but designed it to be different from the system of the native speaker in systematic ways so that the differences between the speakers' production and target norms will not be random. These errors will be relatively stable over a period of time and develop into a mutually intelligible interlanguage among similar types of speakers (Selinker, 1972). For example, the different varieties of English throughout the world such as Malaysian English, Asian English and more are evidence of the Interlanguage Theory. According to Selinker (1972), it is considered 'a dialect whose rules have shared characteristics of two social dialects of languages regardless of whether these languages themselves share rules or not'. The concept of Interlanguage can be further understood through Figure 3.

Figure 3

Illustration of the concept of Interlanguage.



During the process of acquiring the target language (TL), the learner has already prepared certain hypotheses about the rules of the TL, and they are viewed as mental grammars that help create the IL system (Al-khresheh, 2015). However, these mental grammars are often subjected to internal influences such as the learner's own internal processing and external influences such as environmental or cultural factors which may cause the learner's performance in the TL to vary. These influences may be even more prominent in multilinguals as they are required to navigate through more than two sets of languages to form their IL of the TL. These influences results in the learner changing their grammar from time to time by deleting, adding or reconstructing rules in their mental grammar. This process indicates the role of IL in learning the TL. When the TL is fully shaped, the process of changing the IL will stop. Therefore, the entire process of modifying the set of rules while gradually approaching the TL is known as the 'Interlanguage Continuum'. According to Al-khresheh (2015), Selinker also claims that when the learner is attempting to create a sentence in the TL, the latent psychological structures (LPS) are being activated and are described as an 'already forming arrangement' in the brain. Within this LPS, the important notion of fossilisation is brought.

Fossilisation is an important part that appears at a particular point of the IL Continuum, and it is also one of the important mechanisms of the LPS (Al-khresheh, 2015). Selinker's explanation of fossilisation was that 'fossilisable linguistic phenomena are linguistic items, rules and subsystems in which speakers of a certain native language tend to keep in their IL while acquiring a TL regardless of all other factors or instructions they receive in the TL' (Selinker, 1972). It was concluded that many learners of the TL do not achieve full competency due to their progress being halted somewhere in the middle after being affected by errors.

Fossilisation is said to occur at different stages of the language learning process but in the IL Continuum, only around 5% of learners manage to reach the end of their IL Continuum successfully (Birdsong, 1999) while others do not as they fail to overcome fossilisation. Thus, when a learner of the TL stops progressing in the language, their IL will be fossilised, and they will be unable to achieve full competency in the TL. Han (2004) states that it is not uncommon for a speaker that acquires a TL and uses it every day for normal language and has had many years of exposure to it, and still have a strong foreign accent, use non-native grammatical constructions and has non-native intuitions about the types of sentences. Consequently, Fauziati (2011) concluded that fossilisation is characterized by 'permanence' as fossilised errors in the acquired language are permanent, and they will continue to manifest regardless of any further exposure to the TL. It can be said that fossilised errors will still occur in spite of any additional given input and exposure provided for the learner (Al-khresheh, 2015).

In contribution to this study, the IL theory will also be able to help identify if there are any cognitive benefits of multilingualism. As multilingual speakers are constantly required to navigate between more than two sets of language systems (Alshewiter et. al., 2024), internal and external influences may be more than that of their bilingual and monolingual peers while developing the

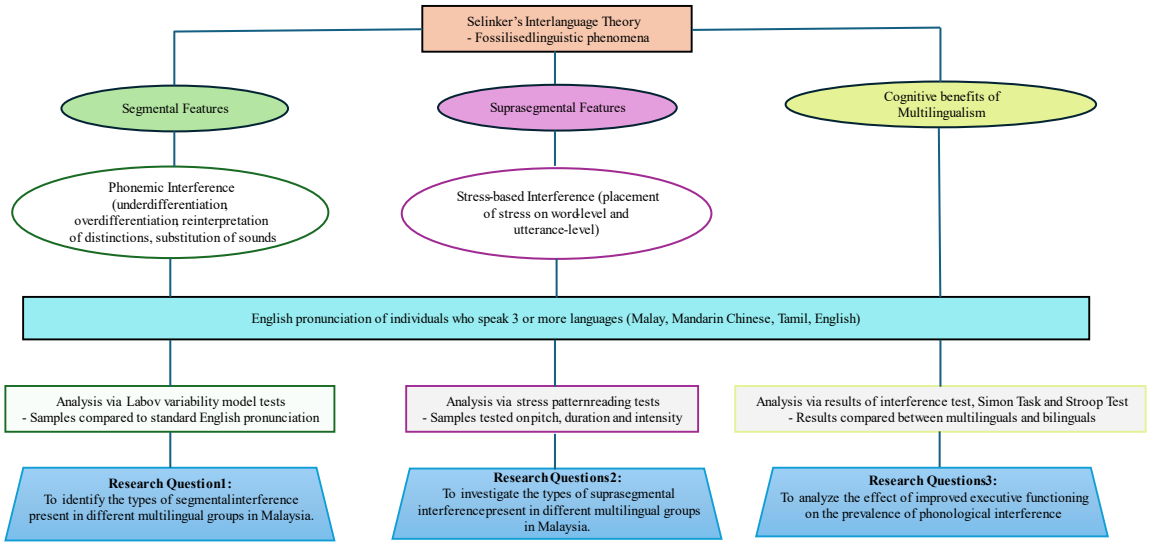
IL such as increased interference from existing language systems which can lead to fossilisation. However, this existing knowledge of language learning can also serve as an advantage for multilinguals as they already have experience learning languages at least twice and will already have a ready set of mental grammars, which can help them to navigate and acquire the TL even more easily as well as achieve full competency efficiently. Therefore, by analyzing the degree of phonological interferences prevalent in multilinguals and bilinguals as well as through the Simon Task and Stroop Test, this study will be able to draw a conclusion on the cognitive advantages of multilingualism.

According to Flege (1979), speakers of two or more languages are bound to make interlanguage identifications because it is an essential characteristic of language to have relations of similarity and differences between sounds, and to extend the phonological system of the native language to include sounds of the TL also helps to ease the psycholinguistic 'burden' of the learner. Therefore, as Malaysia consists of a multilingual population that speaks not only two but many more languages, it would be insightful to investigate the prevalence of fossilisation in Malaysians.

2.4 Conceptual Framework

Figure 4

Diagram of conceptual framework


Selinker's Interlanguage Theory
- Fossilisedlinguistic phenomena
Segmental Features
Suprasegmental Features
Cognitive benefits of Multilingualism
Phonemic Interference (underdifferentiation overdifferentiation reinterpretation of distinctions, substitution of sounds
Stress-based Interference (placement of stress on word-level and utterance-level)
English pronunciation of individuals who speak 3 or more languages (Malay, Mandarin Chinese, Tamil, English)
Analysis via Labov variability model tests
- Samples compared to standard English pronunciation
Analysis via stress patternreading tests
- Samples tested onpitch, duration and intensity
Analysis via results of interference test, Simon Task and Stroop Test
- Results compared between multilinguals and bilinguals
Research Question1:
To identify the types of segmentalinterference present in different multilingual groups in Malaysia.
Research Questions2:
To investigate the types of suprasegmental interferencepresent in different multilingual groups in Malaysia.
Research Questions3:
To analyze the effect of improved executive functioning on the prevalence of phonological interference

Chapter 3

Methodology

3.1 Research Design

This study will adopt a quantitative and qualitative approach. Quantitative methods are used in the form of multiple scales or indices and are focused on the same construct while qualitative methods are usually used in multiple comparison groups (Jick, 1979). In this study, qualitative methods will be employed in terms of the phonological tests which are the Labov variability model, and the stress pattern tests as they require the researcher to be involved and close to the data as well as observe the participants (Morgan, 2013). These tests will also require the researcher to generate theories from observations and they are curated for that particular sample that typically only applies to a limited number of cases (Morgan, 2013). Additionally, quantitative methods will also be used in the form of the Simon Task and Stroop Task as both tests rely on standardized protocols in which the researcher is distant from the data (Morgan, 2013). These tests also aim to test theories through observation of the data and is characterized by generalization and replication as it can be used across many cases (Morgan, 2013).

Firstly, to test for phonological interference, the participants will be required to go through a series of tasks that will examine their perception and production of language sounds in different settings. The tests will adopt the variability model developed by William Labov in 1970 with the purpose of analysing and bringing out the stylistic variation of the participants at a certain period. This model was first introduced by Labov in his study on the social stratification of English in New York City and focuses on style shifting in which the interviews or tests use several different styles with increasing formality as it is effective for identifying the participants' steepness of their stylistic slope (Labov, 2006). According to Ghani (1995), this model has been employed in studies

regarding sound change in native languages in which its application has also been extended to second language acquisition (SLA) such as in studies done by Dickerson (1974) and Tarone (1983). Ghani (1995) has also implemented this model in her study on identifying variability in interlanguage phonology of Malaysian English.

Labov has established that the degree of attention that speakers give to their speech will cause them to shift their styles and has identified five speech styles which are careful style, reading style, word list style, minimal pair style and casual style (Ghani, 1995). In terms of careful style, the participants are engaged in an interview since it consists of formal speech which requires them to pay more attention to their speech. To account for the reading style, participants are required to read dialogues and excerpts from selected texts which will also command their attention to their pronunciation when reading the texts aloud. For word list style, participants are required to read aloud a series of words which they will pay additional attention to speech production when reading the individual words and try to produce the features carefully at a slower pace while in the minimal pair style, the participants will pay their utmost attention to speech production as they can clearly see the difference in the word pairs and will attempt to pronounce the differences as distinctly as possible. This leaves the careful style which will be inseminate in the careful style of the interview in the form of a question concerning dramatic events in their own life after a series of mundane questions so that the participant's attention is diverted, and it will throw them off so that they will not pay attention to their speech. In doing so, the participants will be so involved in retelling their experience that they will let down their guard and pay less attention to their speech which will make them more prone to produce variations that are different from standard English pronunciation.

For testing interference in suprasegmental features, more specifically stress patterns, participants will first be provided with a list of words, compound words and phrases, and asked to

provide different pronunciations in terms of lexical stress to show the different parts of speech of the word as well as the synthetic structure of compounding, such as a noun or a verb. For example, the phrase ‘a Chinese language teacher’ is used to test the participants’ ability to accurately produce stress patterns in terms of noun phrase or adjectival phrase. The participants will also be asked to read polysyllabic words, and they are tested on their ability to identify the profile of stress patterns in the words such as initial stress, medial stress and final stress. Lastly, the participants will be tested on utterance-level stress asked to read out text-prompts and produce stress on the appropriate focuses.

The final tests aim to test the participants executive functioning. Firstly, the Simon Test is conducted to test the participants’ stimulus-response compatibility (SRC) and has been widely used in cognitive psychology and neuroscience to study cognitive functions (Cespón et. al., 2020). Participants will be asked to respond to the words on the laptop screen which are ‘left and ‘right’ with the ‘A’ key on the left side of the keyboard and ‘L’ key on the right side of the keyboard respectively. The words will appear in different positions such as the word ‘left’ appearing on the right side of the screen and the word ‘right’ appearing on the left side of the screen. This creates a spatially incongruent situation where the response location does not correspond with the stimulus location which typically requires a longer reaction time (Cespón et al., 2020). Secondly, the Stroop Task is used to assess the participants’ ability to process more than one stimulus feature simultaneously (Scarpina & Tagini, 2017). Participants will be shown the words ‘red’, ‘green’, ‘blue’ or ‘yellow’ with the words in colour on the laptop screen. They are required to respond to the colour of the words and not the meaning of the words by pressing the corresponding keys such as ‘R’ for red, ‘G’ for green, ‘B’ for blue and ‘Y’ for yellow stimuli. The colour of the words and the meaning of the words may differ, creating an incongruent condition as opposed to a congruent

condition where the colour and meaning of the words correspond to each other. Therefore, the incongruent condition required the participants to perform the less automated task which is naming the word colour while inhibiting the interference from the more automated task which is reading the word (Scarpina & Tagini, 2017). Both the Simon Task and Stroop Task serve to test the participants' ability to inhibit interference in which the Simon Task assesses interference between stimulus and response characteristics while the Stroop Task monitors interference based on conflicting stimulus information.

3.2 Sampling Method

As the focus of this study is to identify the different types of phonological interference that may manifest in the multilingual population in Malaysia, the participants will be selected from the three major ethnic groups of Malaysia which are the Malays, Chinese and Indians. The participants will be selected via the convenience sampling method as it is a cost-effective method and allows for an effortlessly reachable research population (Rahi, 2017) in which researchers can utilize readily available samples or samples that they have access to (Golzar et. al., 2022).

Firstly, an inclusion criterion has been set for this study. A total of 15 participants from either one of these ethnic groups who have achieved proficiency in at least three or more languages including English will be selected to make up the multilingual sample. These 15 participants have different combinations of language repertoires, for example English-Mandarin Chinese-Malay or English-Tamil-Malay. Another 10 participants from these ethnic groups who are proficient in two or less languages including English will then make up the bilingual and monolingual sample. The participants in this study will have occupations ranging from student to retirees from ages 18 to 60 years old in order to achieve a more diverse sample. The participants who fit these criteria will be asked to take part in this study and will be selected into the sample if they consent.

Participants will be required to fill in the Language Experience and Proficiency Questionnaire (LEAP-Q) designed by Marian et. al. (2007) to collect information regarding their language dominance, language exposure, language preference as well as specific characteristics associated with each of the languages such as ages of acquisition and fluency, self-reported estimations of proficiency in speaking, reading and understanding, and more (Kaushanskaya et. al., 2019). This questionnaire is most frequently used by researchers to obtain a comprehensive description of their bilingual sample so that they can be further categorize them into groups and subgroups such as in studies by Ettlinger et. al. (2015). It is also often used in studies for screening bilingual participants by determining their level of language proficiency, identifying their native-speaker status, confirming high language proficiency as well as documenting distinctions in the participants' L1 and L2 language skills which can be seen in studies done by Conrad et. al. (2011), Hespos and Piccin (2008), Lidji et. al. (2011) and Mor et. al. (2014).

3.3 Data Collection

The tests will be carried out in a quiet environment based on the participants' convenience and availability. For example, participants selected from Universiti Tunku Abdul Rahman (UTAR) Kampar had their tests conducted in the university library rooms. The Labov variability model used for testing phonemic interference and the stress pattern tests will be conducted, and the speech production of participants are recorded for analysis. Next, the Simon Task and Stroop Task used to collect data regarding the executive functioning in bilinguals and multilinguals will be conducted. Both these tests will be administered to participants on a DESKTOP-GDOSR2D laptop with a 12-inch monitor and the demo version from PsyToolkit will be used. The Simon Task takes around 2 minutes to complete while the Stroop Task requires around 5 minutes. The results in

terms of response time of both tests will be shown after the test is complete in terms of congruent or incongruent condition followed by the timing.

3.4 Plans for Data Analysis

The recordings of the participants' tests will be analysed through PRAAT as well as through manual comparisons with the phonological characteristics of the other languages that the participant has acquired. The Labov variability model used to test phonemic interference will be analysed via manual comparisons and phonological characteristics in the participants' production of speech that are not characteristics of English phonology will be singled out to be analysed and categorized into one of the four types of phonemic interference as introduced in Uriel Weinreich's interference model. Furthermore, the interferences identified will be further compared with the phonological characteristics of the other languages in the participants' existing language repertoire in order to link them to as phonological interference from their primary, secondary or even tertiary language.

Moving on, the stress patterns tests that are used to test the participants' ability to accurately produce stress patterns will be analyzed via PRAAT to determine the duration and intensity of their utterances as well as pitch. Inconsistent duration, intensity or pitch as compared to standard English will be labelled as interference and compared to suprasegmental features of the languages in their repertoire, similarly to the analysis of phonemic interference, to determine the source of interference.

Lastly, the results in term of response times of the Simon Task and Stroop Task will be collected and analysed via SPSS. The results of the bilinguals will be compared with the results of the

multilinguals in order to determine which group had a faster response time in both congruent and incongruent conditions on both tests.

Chapter 4
Data Analysis

4.1 Segmental interference

In this study, four verbal tasks have been implemented in order to elicit five different speech styles as established by Labov (1966) which are careful and casual style in free conversation task, reading style in dialogue reading task, word list style in reading of word list task and minimal pair style in reading of minimal pair words. These four verbal tasks are intended to represent different situational contexts in order for speakers to produce different styles of speaking in order to accurately determine the severity of segmental interference present as the tasks require a differing degree of attention on speech production (Ghani, 1995). In this section, the variant phonemes produced by the participants are listed down along with examples according to the four verbal tasks and are classified in terms of the four different types of phonemic interference which are underdifferentiation, overdifferentiation, reinterpretation of differences and substitution of sounds.

The participants are labeled according to their dominant language in which English-dominant speakers are represented by the letter ‘E’, Mandarin Chinese-dominant speakers as ‘MC’, Malay-dominant speakers as ‘M’, Tamil-dominant speakers as ‘T’, followed by their number sequence.

4.1.1 Free conversation

In this verbal task, participants were engaged in a conversation in which formal and more serious questions were asked to elicit a careful speech style, followed by a series of more casual questions (Appendix 1) signifying the change to casual style in order to determine whether there was a change in attention to speech production from careful to casual style. The participants did not know the questions beforehand, and the task is treated like an interview. It can be seen that the

participants did not show any difference in speech production throughout the two stylistic environments and produced an equal number of variants in the free conversation task. Moreover, the participants displayed a low degree of attention to their speech production as they were more concerned with the content of their answers. Table 1 shows the variants observed and the examples along with the International Phonetic Alphabet (IPA) transcription of the variant phoneme and the target phoneme in the targeted words.

Table 1

Variant phonemes produced by participants in free conversation task

Variants observed	Target phoneme	Examples			Occurred in
		Word	Variant IPA	Target IPA	
/t/ voiceless alveolar plosive	/θ/ (voiceless dental fricative)	Thing	/tɪŋ/	/θɪŋ/	E4, MC2, MC3, MC4, M1, M2, M4
		Think	/tɪŋk/	/θɪŋk/	
		Strength	/strɛŋt/	/strɛŋθ/	
/d/ voiced alveolar plosive	/ð/ (voiced dental fricative)	They	/deɪ/	/ðeɪ/	E1, MC1, MC3, MC5, MC6, M1, M3, T1
		That	/dæt/	/ðæt/	
		The	/də/	/ðə/	
		This	/dɪs/	/ðɪs/	
/r/ voiced post-alveolar trill	/r/ (voiced post-alveolar approximant)	Right	/raɪt/	/ɻaɪt/	T1, T4
		Extroverted	/ɛkstrəʊvɜːtɪd/	/ɛkstɻəʊvɜːtɪd/	

/s/ voiceless alveolar fricative	/k/ (voiceless velar plosive)	Success	/səsɛs/	/səksɛs/	MC2, MC3, M2
/kʰ/ aspirated voiceless velar plosive	/k/ (voiceless velar plosive)	Music	/mjuːzɪkʰ/	/mjuːzɪk/	T1
/tʃ/ voiced postalveolar affricate	/t/ (voiced alveolar plosive)	Strength	/stʃrɛŋθ/	/strɛŋθ/	MC1, MC3, MC4, MC5
		Strive	/stʃraɪv/	/straɪv/	
		Trouble	/tʃʌbəl/	/trʌbəl/	
/b/ voiced bilabial plosive	/t/ (voiced alveolar plosive)	Debt	/dɛb/	/dɛt/	M1
/tə/ voiced alveolar plosive succeeded with a schwa	/t/ (voiced alveolar plosive)	Strength	/stərɛŋθ/	/strɛŋθ/	T3
/lə/ voiced alveolar lateral approximant succeeded with a schwa	/l/ (voiced alveolar lateral approximant)	Film	/fɪləm/	/fɪlm/	M2

/k/ voiceless velar plosive	/s/ (voiceless alveolar fricative)	Sci-fi	/skaɪfaɪ/	/saɪfaɪ/	MC2
		Electrician	/ɪlɛktrɪkʃən/	/ɪlɛktrɪʃən/	
/ʃ/ voiceless postalveolar fricative	/s/ (voiceless alveolar fricative)	Sushi	/suːʃi/	/ʃuːʃi/	MC6
/ɑː/ low central lax vowel	/æ/ (low front lax vowel)	Mass	/ mɑːs/	/mæs/	T4
/ɑː/ low central lax vowel	/ʌ/ (mid central lax vowel)	Money	/mɑːni/	/mʌni/	E1
/əʊ/ mid central lax vowel to high back lax vowel	/ɒ/ (mid central lax vowel)	Knowledge	/nəʊlɪʤ/	/nɒlɪʤ/	MC1
/Ø/ omission of sound	/k/ (voiceless velar plosive)	Like	/laɪ/	/laɪk/	M1
/Ø/ omission of sound	/θ/ (voiceless dental fricative)	Strength	/strɛŋ/	/strɛŋθ/	M3, M4

4.1.2. Dialogue reading

Participants were given a dialogue that took approximately one and a half minutes to read (Appendix 2). Participants were told to jump straight into the conversation without reading the names of the speakers, Mrs Randal and Mrs Reed. In this task, it can be observed that the participants showed a lower degree of attention to their speech production as well in order to maintain a more natural and smooth flow. Furthermore, the content of the dialogue was similar to normal, daily life conversations and consisted of familiar words. Thus, it can be assumed that any variants produced in this task stems from underdeveloped interlanguage and not unfamiliarity of the words. Table 2 shows the variants observed and the examples along with the International Phonetic Alphabet (IPA) transcription of the variant phoneme and the target phoneme in the targeted words.

Table 2

Variant phonemes produced by participants in dialogue reading task

Variants observed	Target phoneme	Examples			Occurred in
		Word	Variant IPA	Target IPA	
/t/ voiceless alveolar plosive	/θ/ (voiceless dental fricative)	Cathay	/kæteɪ/	/kæθeɪ/	E1, E4, E5, MC1, MC3, MC4, MC5, MC6, M1, M4, T1, T3, T4
		Thank	/tæŋk/	/θæŋk/	
		Ruth	/ruːt/	/ruːθ/	
		Third	/tɜːd/	/θɜːd/	

/f/ voiceless labiodental fricative	/θ/ (voiceless dental fricative)	Ruth	ruːf/	/ruːθ/	E1, E4, E6, MC1, MC2, T1
/d/ voiced alveolar plosive	/ð/ (voiced dental fricative)	That	/dæt/	/ðæt/	E6, MC4, M1, M4
		The	/də/	/ðə/	
		This	/dɪs/	/ðɪs/	
/f/ voiceless labiodental fricative	/v/ (voiced labio-velar approximant)	Twelve	/twɛlf/	/twɛlv/	E1, MC1, MC3, MC4, MC6, M1, M2, M3, M4, T1, T2, T3
/l/ voiced alveolar lateral approximant	/r/ (voiced post-alveolar approximant)	Ribs	/lɪbz/	/rɪbz/	MC3
/bə/ voiced bilabial plosive succeeded with a schwa	/b/ (voiced bilabial plosive)	Terribly	/tɛrəbəli/	/tɛrəbli/	MC3, MC6, T3, T4

/k/ voiceless velar plosive	/s/ (voiceless alveolar fricative)	Electrician	/ɪlɛktrɪkʃən/	/ɪlɛktrɪʃən/	MC1
/d/ voiced alveolar plosive	/t/ (voiced alveolar plosive)	Pretty	/prɪdi/	/prɪti/	M4
/tʃ/ voiced postalveolar affricate	/t/ (voiced alveolar plosive)	Terribly	/tʃɛrəbli/	/tɛrəbli/	MC5
/ɑː/ low central lax vowel	/uː/ (high back tense vowel)	Ruth	/rɑːf/	/ruːθ/	MC5, M2
/aʊ/ low central lax vowel to high back lax vowel	/ɔː/ (mid central lax vowel)	Laura	/laʊrə/	/lɔːrə/	MC1, M1
/Ø/ omission of sound	/ɻ/ (voiced retroflex approximant)	Librarian:	/laɪˈbeəriən/	/laɪˈbreəriən/	MC1, MC3, MC4, MC5, MC6, M1, M3
		Secretary	/sɛkətəri/	/sɛkrətəri/	
		Library	/laɪbəri/	/laɪbrəri	

4.1.3. Word list

In the third verbal task, participants were provided with a list of 17 words (Appendix 3). These words contain specific phonemes that are assumed to be pronounced in variation by speakers from different language backgrounds. The participants were asked to read each word clearly and slowly in order to elicit more accurate pronunciation and avoid them rushing through the word list. This resulted in a higher degree of attention to their speech production as well as a higher accuracy in pronunciation as the participants tended to drag out the syllables of each word, producing clearer sounds. As this task also consisted of familiar words, variants observed can be attributed to the participants' underdeveloped interlanguage. Table 3 shows the variants observed and the examples along with the International Phonetic Alphabet (IPA) transcription of the variant phoneme and the target phoneme in the targeted words.

Table 3

Variant phonemes produced by participants in reading of word list task

Variants observed	Target phoneme	Examples			Occurred in
		Word	Variant IPA	Target IPA	
/t/ voiceless alveolar plosive	/θ/ (voiceless dental fricative)	Mouth	/maʊt/	/maʊθ/	E1, E4, E5, E6, MC1, MC3, MC4, MC6, M1, M4, T1, T4
		Think	/tɪŋk/	/θɪŋk/	
		Thunder	/tʌndə/	/θʌndə/	

/f/ voiceless labiodental fricative	/θ/ (voiceless dental fricative)	Mouth	/maʊf/	/maʊθ/	E6, MC4, MC5, MC6
/t/ voiceless alveolar plosive	/d/ (voiced alveolar plosive)	Road	/rəʊt/	/rəʊd/	M4, T1
/f/ voiceless labiodental fricative	/v/ (voiced labio-velar approximant)	Halve	hɑːf/	/hɑːv/	E1, E2, MC1, MC2, MC4, MC5, MC6, T1, T2, T4
/lə/ voiced alveolar lateral approximant succeeded with a schwa	/l/ (voiced alveolar lateral approximant)	Film	/fɪləm/	/fɪlm/	MC4, MC5

4.1.4 Minimal pairs

Participants were presented with 12 pairs of words in which both words in a pair have similar pronunciation (Appendix 4). Once again, the participants were asked to pronounce the words slowly and carefully to ensure a clearer distinction between the pair words. This task also showed a higher degree of attention from participants regarding their speech production. However,

majority of participants still displayed a few variant phonemes, particularly their inability to differentiate between short and long vowels, causing them to have the same pronunciation for two different words. Table 4 shows the variants observed and the examples along with the International Phonetic Alphabet (IPA) transcription of the variant phoneme and the target phoneme in the targeted words.

Table 4

Variant phonemes produced by participants in reading of minimal pair words task

Variants observed	Target phoneme	Examples			Occurred in
		Word	Variant IPA	Target IPA	
/t/ voiceless alveolar plosive	/θ/ (voiceless dental fricative)	Thin	/tɪn/	/θɪn/	E1, E3, E5, E6, MC1, MC3, MC4, MC6, M1, M4, T3, T4
		Three	/tri:/	/θri:/	
/t/ voiceless alveolar plosive	/ð/ (voiced dental fricative)	With	/wɪt/	/wɪð/	MC3
/d/ voiced alveolar plosive	/ð/ (voiced dental fricative)	They	/deɪ/	/ðeɪ/	E1, E4, MC1, MC2, MC3, MC4, MC5,

					MC6, M1, M4, T2, T3
/v/ voiced labiodental fricative	/w/ (voiced labio-velar approximant)	When	/vɛn/	/wɛn/	E5, E6
/w/ voiced labio-velar approximant	/v/ (voiced labiodental fricative)	Van	/wæn/	/væn/	E4, MC3
/b/ voiced bilabial plosive	/p/ (voiceless bilabial plosive)	Mop	/mɒb/	/mɒp/	E6, MC3, MC4, MC5, MC6, M1, M2, M3
/g/ voiced velar plosive	/k/ (voiceless velar plosive)	Dock	/dɒg/	/dɒk/	E6, MC5, MC6
/ɪ/ high front lax vowel	/i:/ (high front tense vowel)	Sheep	/ʃɪp/	/ʃi:p/	E4, E6, MC1, MC2, MC3, MC4, MC6, M1, M3, M4, T3
		Beat	/bɪt/	/bi:t/	
/ɛ/ mid front lax vowel	/i:/ (high front tense vowel)	Breathe	/brɛð/	/bri:ð/	MC5, M1, M2, M3

/ɛ/ mid front lax vowel	/æ/ (low front lax vowel)	Pat	/pɛt/	/pæt/	E4, E5, E6, MC1, MC2, MC3, MC4, MC5, MC6, M1, M2, M3, M4, T1, T2, T3, T4

4.1.5 Classification into Phonological Interference Categories

According to Weinreich (1957), there are four types of phonemic interference which are underdifferentiation, overdifferentiation, reinterpretation of differences, and substitution of sounds. The variant phonemes as identified from the four different verbal tasks are categorized according to the type of interference based on influence from the speakers' dominant language, which is referred to as their first language (L1).

The first type of phonemic interference is underdifferentiation. Underdifferentiation can be understood as when a non-native English speaker assumes sounds in English to be redundant due to influence from their native language. This type of interference did not occur as much as the other types of interference among the participants, albeit being observed through all four verbal tasks. Majority of variants occurred in Mandarin Chinese- and Malay-dominant speakers displaying one to three types of variants while there are two English-dominant speakers, one Mandarin Chinese-, Malay- and Tamil-dominant speaker who each displayed only one type of variant. the highest-occurring variant of underdifferentiation is /ɪ/, the high front lax vowel from the target phoneme /iː/ which is a high front tense vowel. This variant occurred in all language

groups especially in Mandarin Chinese and Malay speakers. The table below shows the variants produced by participants throughout all four verbal tasks that are identified as underdifferentiation.

Table 5

Variant phonemes classified as underdifferentiation

Variant	Target phoneme	Examples			Language group	Justification
		Word	Variant IPA	Target IPA		
/∅/ omission of sound	/k/ (voiceless velar plosive)	Like	/laɪ/	/laɪk/	M1	Assumption that the /k/ sound is redundant due to absence of coda being consonant followed by a vowel in L1
/∅/ omission of sound	/θ/ (voiceless dental fricative)	Strength	/strɛŋ/	/strɛŋθ/	M3, M4	Assumption that the /θ/ sound is redundant due to absence of consonant clusters in L1

/Ø/ omission of sound	/ɻ/ (voiced retroflex approximant)	Librarian	/laɪˈbeəriən/	/laɪˈbreəriən/	MC1, MC3, MC4, MC5, MC6, M1, M3	Assumption that the /ɻ/ sound is redundant due to absence of consonant clusters in L1
		Secretary	/sɛkətəri/	/sɛkrətəri/		
		Library	/laɪbəri/	/laɪbrəri/		
/s/ voiceless alveolar fricative	/k/ (voiceless velar plosive)	Success	/səsɛs/	/səksɛs/	MC2, MC3, M2	Absence of /k/ sound due to cluster consonants being absent in L1
/ɪ/ high front lax vowel	/i:/ (high front tense vowel)	Sheep	/ʃɪp/	/ʃi:p/	E4, E6, MC1, MC2, MC3, MC4, MC6, M1, M3, M4, T3	Absence of differentiation between long and short vowels in L1
		Beat	/bɪt/	/bi:t/		

The second type of phonemic interference that can be observed is overdifferentiation. In simple terms, overdifferentiation is when a speaker assumes a feature of their native language to

be distinctive but is redundant in English. In this study, overdifferentiation has been observed as the least occurring type of interference and can be observed in free conversation task, dialogue reading task, and word list task. All participants who exhibited overdifferentiation are Mandarin Chinese-dominant speakers and Tamil-dominant speakers, in which all of them only produce one variant except for one Tamil-dominant speaker who showed two variants. The most-occuring variant could be seen when participants included a redundant schwa sound /ə/ behind another phoneme such as /t/ and /l/. The table below shows the variants produced by participants throughout all four verbal tasks that are identified as overdifferentiation.

Table 6

Variant phonemes classified as overdifferentiation

Variant	Target phoneme	Examples			Language group	Justification
		Word	Variant IPA	Target IPA		
/kʰ/ aspirated voiceless velar plosive	/k/ (voiceless velar plosive)	Music	/mjuːzɪkʰ/	/mjuːzɪk/	T1	Tendency for aspirated stops in L1 which is redundant in English.
/tə/ voiced alveolar plosive succeeded with a schwa	/t/ (voiced alveolar plosive)	Strength	/stərɛŋθ/	/strɛŋθ/	T3	Tendency for speakers to pronounce every syllable in L1
/lə/ voiced alveolar lateral approximant succeeded	/l/ (voiced alveolar lateral approximant)	Film	/fɪləm/	/fɪlm/	M2, MC4, MC5	Tendency for speakers to pronounce every syllable in L1

with a schwa						
/bə/ voiced bilabial plosive succeeded with a schwa	/b/ (voiced bilabial plosive)	Terribly	/tɛrəbəli/	/tɛrəbli/	MC3, MC6, T3, T4	Tendency for speakers to pronounce every syllable in L1
/k/ voiceless velar plosive	/s/ (voiceless alveolar fricative)	Sci-fi	/skaɪfaɪ/	/saɪfaɪ/	MC1, MC2	Redundant /k/ sound due to absence of consonant clusters in L1
		Electrician	/ɪlɛktrɪkʃən/	/ɪlɛktrɪʃən/		

The third type of phonemic interference that can be observed is reinterpretation of differences. Reinterpretation of differences can be understood as when a speaker associates a phoneme in their dominant language to be similar to the actual phoneme in English and produces the phoneme as perceived in their dominant language's sound system. It can be observed that reinterpretation of differences is the most-occurring type of interference that occurred in all of the language groups and throughout all four verbal tasks. The variants ranged from one variant to six variants produced by a participant. The variant with the highest frequency is the reinterpretation of participants of the /θ/ phoneme into /t/ according to the sound system in their dominant language. The table below shows the variants produced by participants throughout all four verbal tasks that are identified as reinterpretation of differences.

Table 7

Variant phonemes classified as reinterpretation of differences

Variant	Target phoneme	Examples			Language group	Justification
		Word	Variant IPA	Target IPA		
/t/ voiceless alveolar plosive	/θ/ (voiceless dental fricative)	Thing	/tɪŋ/	/θɪŋ/	E1, E3, E4, E5, E6, MC1, MC2, MC3, MC4, MC5, MC6, M1, M2, M4, T1, T3, T4	Absence of /θ/ sound in L1 and is reinterpreted as another similar sound present in L1
		Think	/tɪŋk/	/θɪŋk/		
		Strength	/strɛŋt/	/strɛŋθ/		
		Mouth	/maʊt/	/maʊθ/		
		Thunder	/tʌndə/	/θʌndə/		
		Thin	/tɪn/	/θɪn/		
		Three	/tri:/	/θri:/		
		Cathay	/kæteɪ/	/kæθeɪ/		
		Ruth	/ru:t/	/ru:θ/		
		Third	/tɜ:d/	/θɜ:d/		
/f/ voiceless labiodental fricative	/θ/ (voiceless dental fricative)	Ruth	/ru:f/	/ru:θ/	E1, E4, E6, MC1, MC2, MC4, MC5, MC6, T1	Absence of /θ/ sound in L1 and is reinterpreted as another similar sound present in L1
		Mouth	/maʊf/	/maʊθ/		
		They	/deɪ/	/ðeɪ/	E1, E4, E6, MC1,	Absence of /ð/ sound in L1 and is
		That	/dæt/	/ðæt/		

/d/ voiced alveolar plosive	/ð/ (voiced dental fricative)	The	/də/	/ðə/	MC2, MC3, MC4, MC5, MC6, M1, M3, M4, T1, T2, T3	reinterpreted as another similar sound present in L1
		This	/dɪs/	/ðɪs/		
/t/ voiceless alveolar plosive	/ð/ (voiced dental fricative)	With	/wɪt/	/wɪð/	MC3	Absence of /ð/ sound in L1 and is reinterpreted as another similar sound present in L1
/r/ voiced post-alveolar trill	/r/ (voiced post-alveolar approximant)	Right	/raɪt/	/ɻaɪt/	T1, T4	Retroflex approximant position is reinterpreted as a trill due to tendency to roll the /r/ sound in L1
		Extroverted	/ɛkstrəʊvɜːtɪd/	/ɛkstɻəʊvɜːtɪd/		

/b/ voiced bilabial plosive	/p/ (voiceless bilabial plosive)	Mop	/mɒb/	/mɒp/	E6, MC3, MC4, MC5, MC6, M1, M2, M3	Reinterpretation of the /p/ sound with /b/ due to lack of contrast of these sounds as coda in L1
/g/ voiced velar plosive	/k/ (voiceless velar plosive)	Dock	/dɒg/	/dɒk/	E6, MC5, MC6	Reinterpretation of the /k/ sound with /g/ due to lack of contrast of these sounds as coda in L1
/ʃ/ voiceless postalveolar fricative	/s/ (voiceless alveolar fricative)	Sushi	/ʃuːʃi/	/suːʃi/	MC6	Reinterpretation of postalveolar fricative position instead of alveolar fricative due to lack of distinction in L1
/ɑː/ low central tense vowel	/ʌ/ (mid central lax vowel)	Money	/mɑːni/	/mʌni/	E1	Reinterpretation of /ʌ/ to /ɑː/ due to assumption of these sounds being interchangeable

/ɑː/ low central tense vowel	/æ/ (low front lax vowel)	Mass	/mɑːs/	/mæs/	T4	Lack of /æ/ sound in L1 causing it to be reinterpreted as a similar sound in L1
/ɛ/ mid front lax vowel	/æ/ (low front lax vowel)	Pat	/pɛt/	/pæt/	E4, E5, E6, MC1, MC2, MC3, MC4, MC5, MC6, M1, M2, M3, M4, T1, T2, T3, T4	Diphthongs are simplified to a similar sound in L1
/əʊ/ mid central lax vowel to high back lax vowel	/ɒ/ (mid central lax vowel)	Knowledge	/nəʊlɪʤ/	/nɒlɪʤ/	MC1	Monophthongs are reinterpreted to a similar sound in L1 directly according to the spelling of the word

/aʊ/ low central lax vowel to high back lax vowel	/ɔː/ (mid central lax vowel)	Laura	/laʊrə/	/lɔːrə/	MC1, M1	Monophthongs are reinterpreted to a similar sound in L1 directly according to the spelling of the word

Lastly, the fourth type of phonemic interference is the substitution of sounds. To better understand it, substitution of sounds is when a speaker substitutes the closest phoneme from their dominant language with the original phoneme in English due to an absence of that particular phoneme in their dominant language. The frequency of substitution of sounds is also relatively high among the participants and can be observed throughout all four verbal tasks. This type of interference occurred in all language groups with variants ranging from one to four variants in a participant. The most prominent type of variant under substitution of sounds is the substitution of the phoneme /w/ for the variant phoneme /v/. The table below shows the variants produced by participants throughout all four verbal tasks that are identified as reinterpretation of differences.

Table 8

Variant phonemes classified as substitution of sounds

Variant	Target phoneme	Example			Language group	Justification
		Word	Variant IPA	Target IPA		
		Strength	/stʃrɛŋθ/	/strɛŋθ/		

/tʃ/ voiced postalveolar affricate	/t/ (voiced alveolar plosive)	Strive	/stʃraɪv/	/straɪv/	MC1, MC3, MC4, MC5	/t/ sound is substituted for /tʃ/ due to absence of consonant clusters in L1
		Trouble	/tʃʌbəl/	/trʌbəl/		
		Terribly	/tʃɛrəbəli/	/tɛrəbli/		
/b/ voiced bilabial plosive	/t/ (voiceless alveolar plosive)	Debt	/dɛb/	/dɛt/	M1	/t/ sound is substituted for /b/ due to absence of consonant clusters in L1
/d/ voiced alveolar plosive	/t/ (voiceless alveolar plosive)	Pretty	/prɪdi/	/prɪti/	M4	/t/ sound is substituted for /d/ as perceived to be similar sounds
/t/ voiceless alveolar plosive	/d/ (voiced alveolar plosive)	Road	/rəʊt/	/rəʊd/	M4, T1	/d/ sound is substituted for /t/ as perceived to be interchangeable
/v/ voiced labiodental fricative	/w/ (voiced labio-velar	When	/vɛn/	/wɛn/	E5, E6	/w/ sound is substituted for /v/ as perceived to be interchangeable

	approximant)					
/w/ voiced labio-velar approximant	/v/ (voiced labiodental fricative)	Van	/wæn/	/væn/	E4, MC3	/v/ sound is substituted for /w/ as perceived to be interchangeable
/f/ voiceless labiodental fricative	/v/ (voiced labio-velar approximant)	Twelve	/twɛlf/	/twɛlv/	E1, E2, MC1, MC2, MC3, MC4, MC5, MC6, M1, M2, M3, M4, T1, T2, T3, T4	/v/ sound is substituted for /v/ as perceived to be interchangeable
		Halve	/hɑːf/	/hɑːv/		
/l/ voiced alveolar	/r/ (voiced post-	Ribs	/lɪbz/	/rɪbz/	MC3	/ɻ/ sound is substituted for /l/ as

lateral approximant	alveolar approximant)					perceived to be interchangeable

4.2 Suprasegmental interference

The next section displays the suprasegmental interference in terms of stress patterns in the participants. The reading tests on suprasegmental interference are conducted right after the four verbal tasks in the form of reading of polysyllabic word list, reading of compound word list, and reading of sentences. Each test serves to identify any variants in stress patterns from the participants and are compared with the correct stress and tone of that in RP.

4.2.1 Stress variation in polysyllabic words

Participants were asked to read a list of 16 polysyllabic words clearly and slowly (Appendix 5). Most of the participants were able to produce stress on certain syllables albeit not being accurate while some participants tend to pronounce most words with no differing stress. To analyze the variation in stress patterns more accurately, the audio recordings of the participants' reading tests are analyzed via PRAAT software to generate spectrograms of participants' pronunciation. The produced words of the participants are each compared with spectrograms of the targeted word in Received Pronunciation (RP) taken from Cambridge Dictionary to determine any variations in stress patterns. The blue line in the spectrograms represents the pitch of the participant in pronouncing the word while the green line shows the intensity, which will be analyzed to determine the stress pattern of the word. A metrical grid showing the different degrees of stress placement according to RP and the participants' pronunciations are also included. Tables

9 to 36 and Figures 1 to 28 show the analysis of pronunciation of polysyllabic words in RP along with the variant stress patterns produced by participants.

4.2.1.1 Comfortable

Table 9

Metrical Grid of Stress Placement of the word 'Comfortable' in RP

Line 2	x	-	-	-
Line 1	-	-	-	x
Line 0	-	x	x	-
Phonemes	kʌm	fə	tə	bəl

Figure 1

Spectrogram of Stress Placement of the word 'Comfortable' in RP

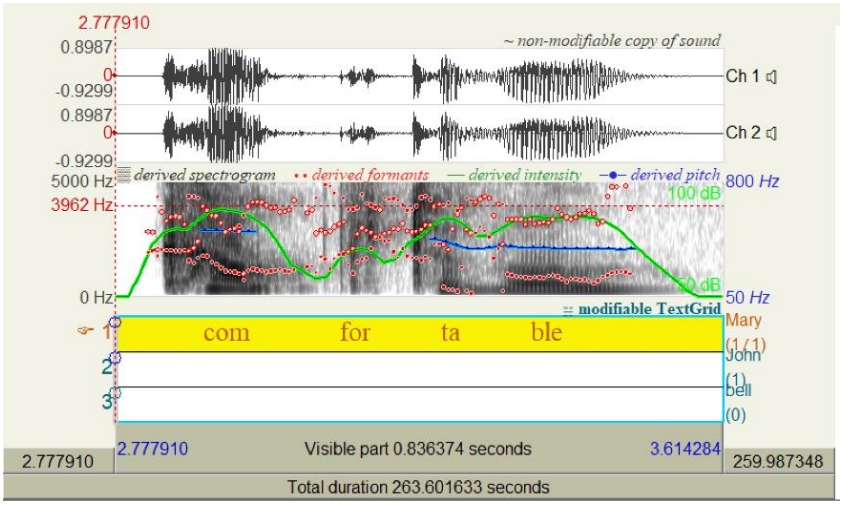


Table 10

Metrical Grid of Stress Placement of the word 'Comfortable' in Variant 1

Line 2	-	x	-	-
Line 1	x	-	x	-
Line 0	-	-	-	x
Phonemes	kʌm	fə	tə	bəl

Figure 2

Spectrogram of Stress Placement of the word 'Comfortable' in Variant 1

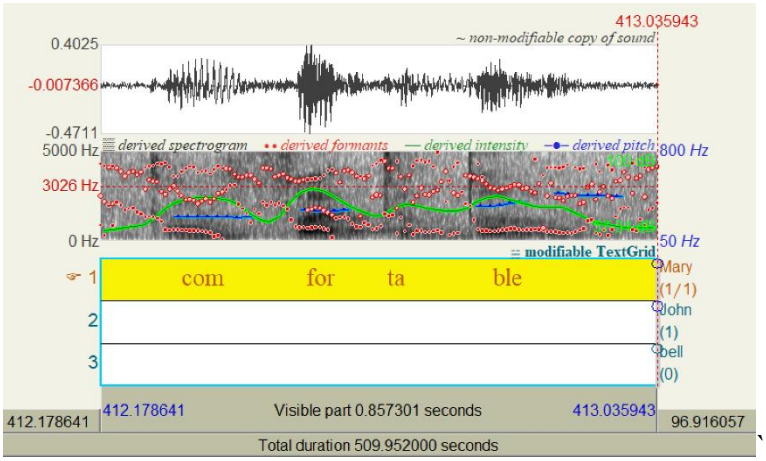


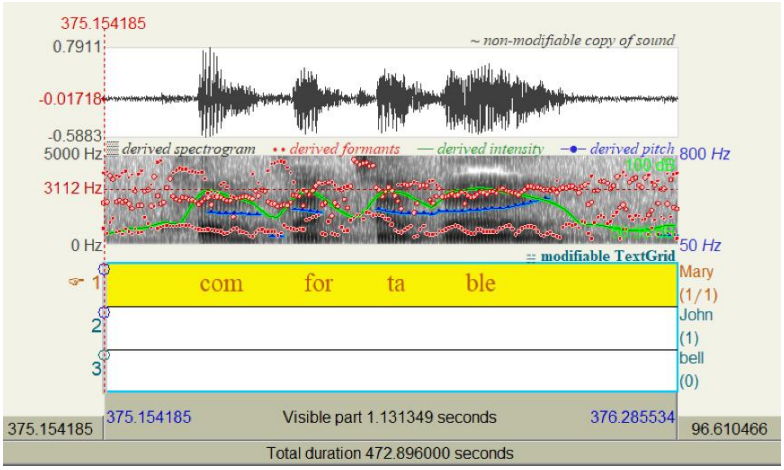
Table 11

Metrical Grid of Stress Placement of the word 'Comfortable' in Variant 2

Line 2	-	-	-	-
Line 1	x	x	x	x
Line 0	-	-	-	-
Phonemes	kʌm	fə	tə	bəl

Figure 3

Spectrogram of Stress Placement of the word 'Comfortable' in Variant 2



4.2.1.2 Interesting

Table 12

Metrical Grid of Stress Placement of the word 'Interesting' in RP

Line 2	x	-	-
Line 1	-	-	x
Line 0	-	x	-
Phonemes	ɪnt	rɛs	tɪŋ

Figure 4

Spectrogram of Stress Placement of the word 'Interesting' in RP

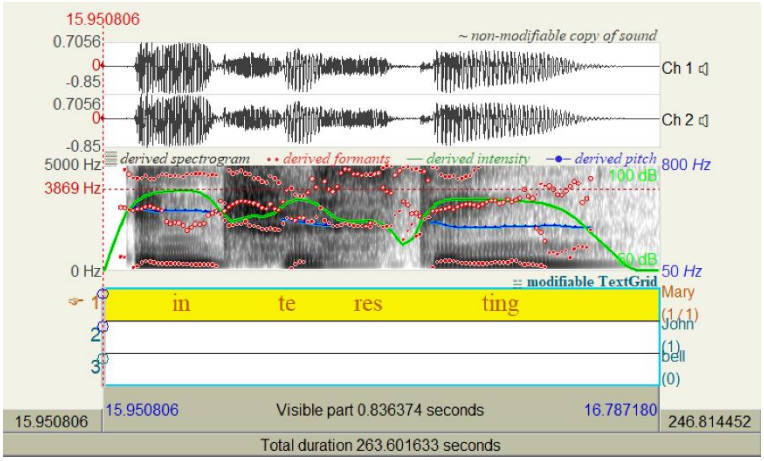


Table 13

Metrical Grid of Stress Placement of the word 'Interesting' in Variant 1

Line 2	-	-	-	-
Line 1	x	x	x	x
Line 0	-	-	-	-
Phonemes	ɪn	tə	rɛs	tɪŋ

Figure 5

Spectrogram of Stress Placement of the word 'Interesting' in Variant 1

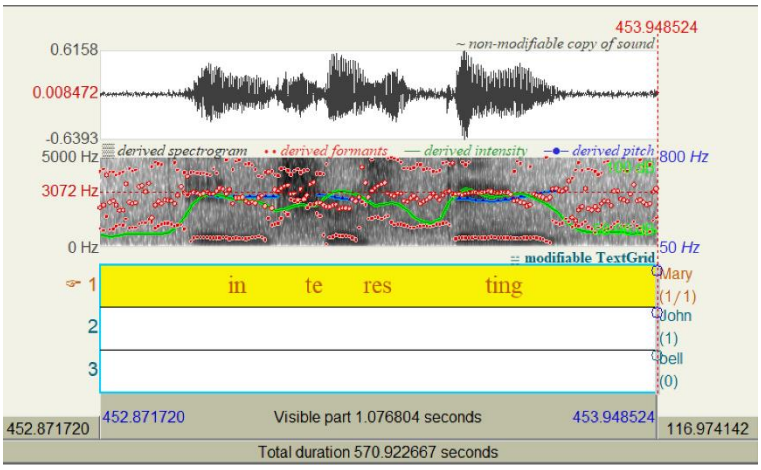


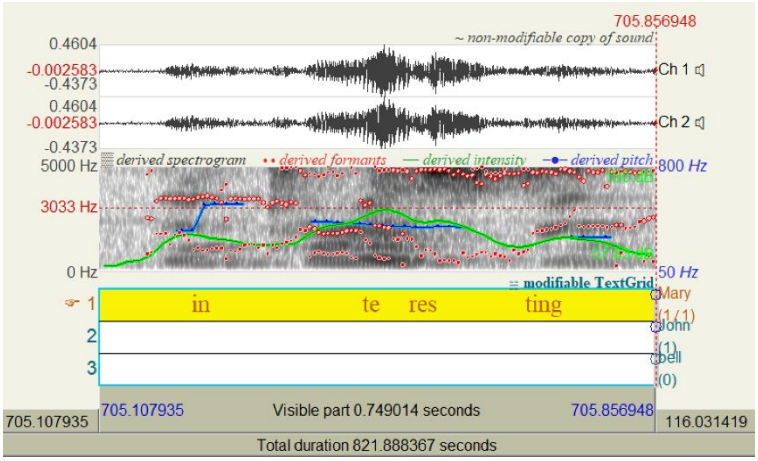
Table 14

Metrical Grid of Stress Placement of the word 'Interesting' in RP

Line 2	-	x	-
Line 1	-	-	-
Line 0	x	-	x
Phonemes	ɪnt	rɛs	tɪŋ

Figure 6

Spectrogram of Stress Placement of the word 'Interesting' in Variant 2



4.2.1.3. Responsibility

Table 15

Metrical Grid of Stress Placement of the word 'Responsibility' in RP

Line 2	-	x	-	-	-	-
Line 1	x	-	x	x	-	-
Line 0	-	-	-	-	x	x
Phonemes	rɪs	pɒn	sɪ	bɪ	lə	ti

Figure 7

Spectrogram of Stress Placement of the word 'Responsibility' in RP

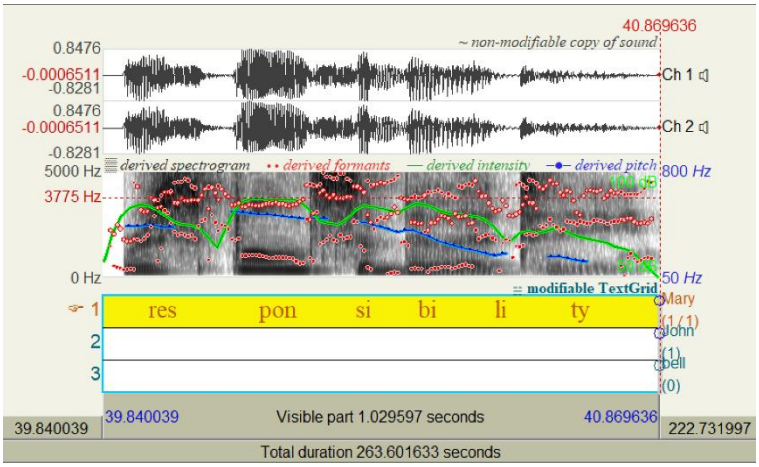


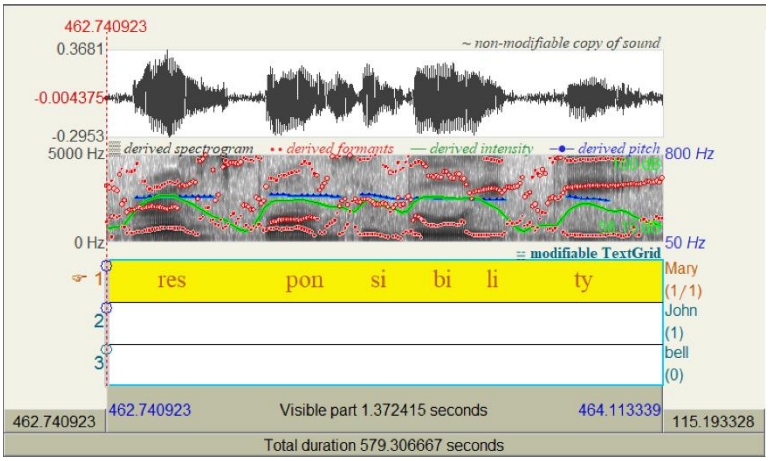
Table 16

Metrical Grid of Stress Placement of the word 'Responsibility' in Variant 1

Line 2	-	-	-	-	-	-
Line 1	x	x	x	x	x	x
Line 0	-	-	-	-	-	-
Phonemes	rɪs	pɒn	sɪ	bɪ	lə	ti

Figure 8

Spectrogram of Stress Placement of the word 'Responsibility' in Variant 1



4.2.1.4 Vocabulary

Table 17

Metrical Grid of Stress Placement of the word 'Vocabulary' in RP

Line 2	-	x	-	-	-
Line 1	x	-	x	x	x
Line 0	-	-	-	-	-
Phonemes	və	kæ	bjə	lᵊ	ri

Figure 9

Spectrogram of Stress Placement of the word 'Vocabulary' in RP

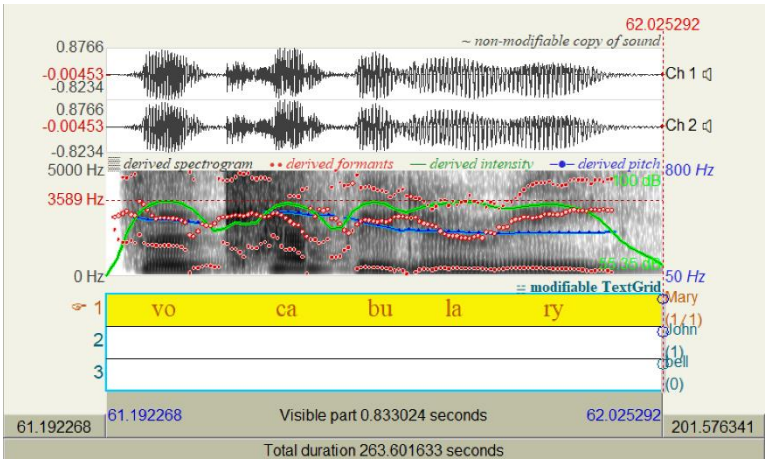


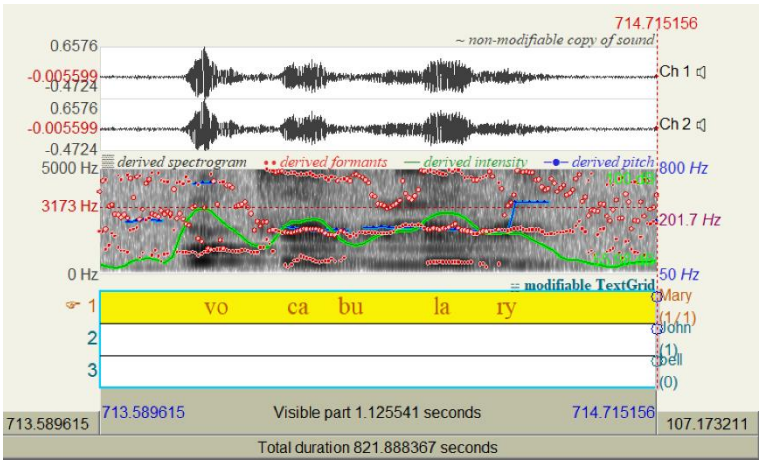
Table 18

Metrical Grid of Stress Placement of the word 'Vocabulary' in Variant 1

Line 2	x	-	-	-	-
Line 1	-	x	-	x	-
Line 0	-	-	x	-	x
Phonemes	və	kæ	bjə	lᵊ	ri

Figure 10

Spectrogram of Stress Placement of the word 'Vocabulary' in Variant 1



4.2.1.5 Economy

Table 19

Metrical Grid of Stress Placement of the word 'Economy' in RP

Line 2	-	x	-	-
Line 1	x	-	x	-
Line 0	-	-	-	x
Phonemes	ɪ	kɒ	nə	mi

Figure 11

Spectrogram of Stress Placement of the word 'Economy' in RP

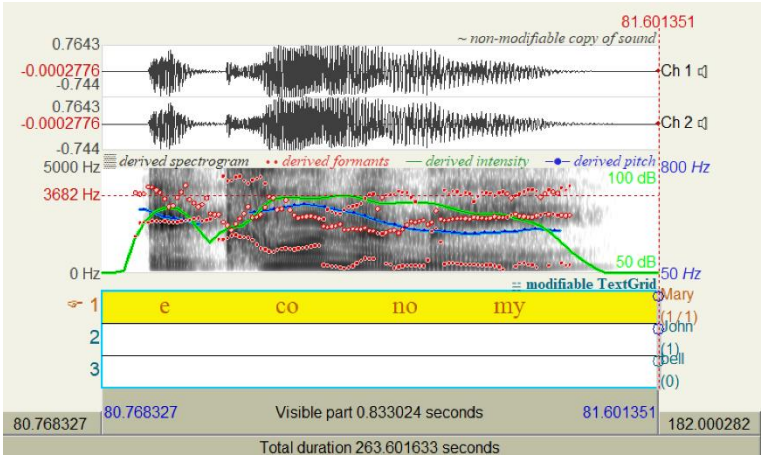


Table 20

Metrical Grid of Stress Placement of the word 'Economy' in Variant 1

Line 2	x	-	-	-
Line 1	-	x	x	-
Line 0	-	-	-	x
Phonemes	ɪ	kɒ	nə	mi

Figure 12

Spectrogram of Stress Placement of the word 'Economy' in Variant 1

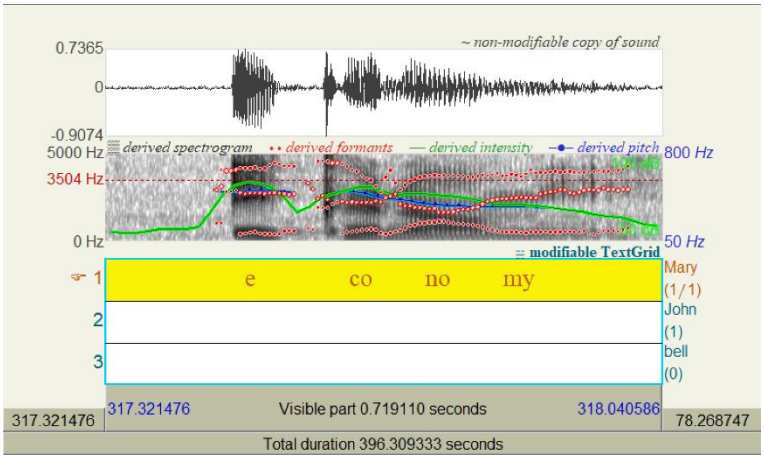


Table 21

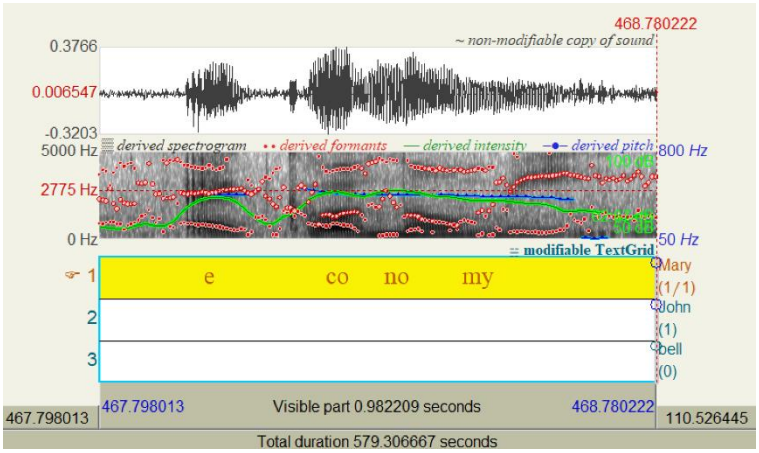
Metrical Grid of Stress Placement of the word 'Economy in Variant 2

Line 2	-	-	-	-

Line 1	x	x	x	x
Line 0	-	-	-	-
Phonemes	ɪ	kɒ	nə	mi

Figure 13

Spectrogram of Stress Placement of the word 'Economy' in Variant 2



4.2.1.6 Facility

Table 22

Metrical Grid of Stress Placement of the word 'Facility' in RP

Line 2	-	x	-	-
Line 1	x	-	-	-
Line 0	-	-	x	x
Phonemes	fə	sɪ	lə	ti

Figure 14

Spectrogram of Stress Placement of the word 'Facility' in RP

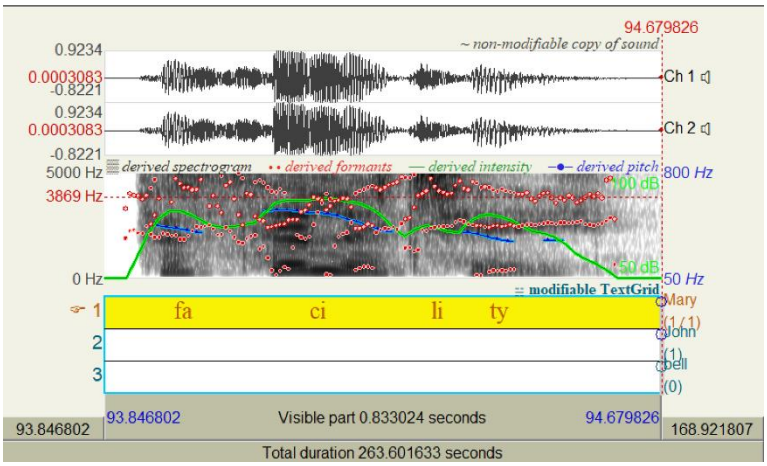


Table 23

Metrical Grid of Stress Placement of the word 'Facility' in Variant 1

Line 2	-	-	-	-
Line 1	x	x	x	x
Line 0	-	-	-	-
Phonemes	fə	sɪ	lə	ti

Figure 15

Spectrogram of Stress Placement of the word 'Facility' in Variant 1

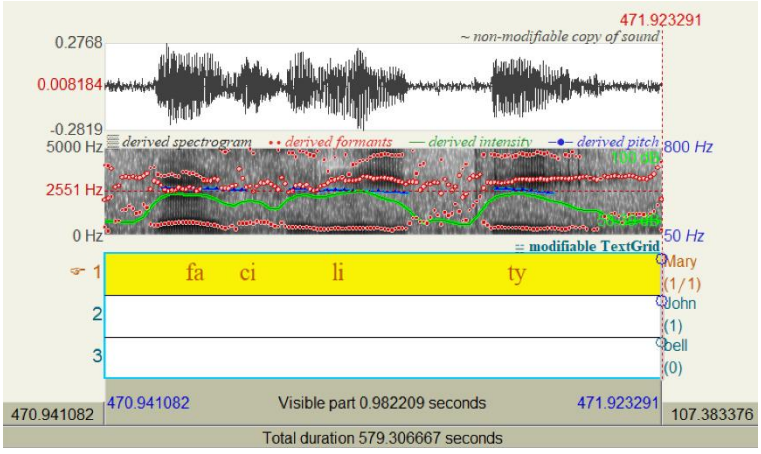


Table 24

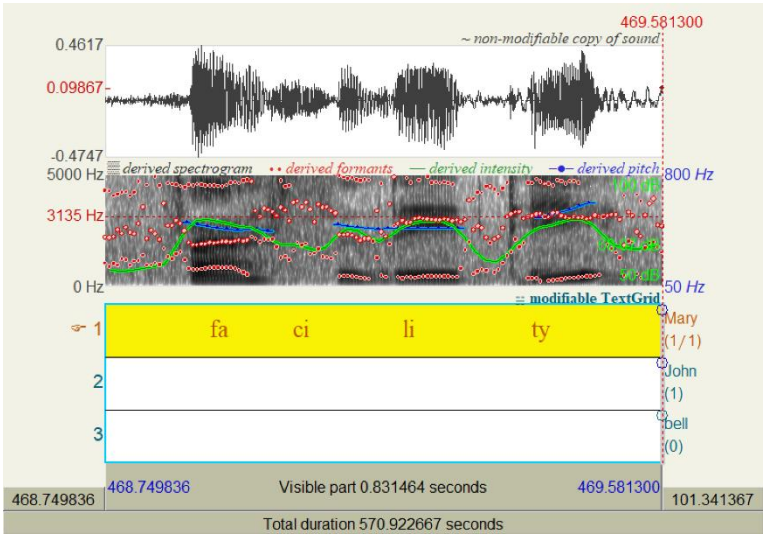
Metrical Grid of Stress Placement of the word 'Facility' in Variant 2

Line 2	x	-	-	-

Line 1	-	x	x	-
Line 0	-	-	-	x
Phonemes	fə	sɪ	lə	ti

Figure 16

Spectrogram of Stress Placement of the word 'Facility' in Variant 2



4.2.1.7 Invisible

Table 25

Metrical Grid of Stress Placement of the word 'Invisible' in RP

Line 2	-	x	-	-
Line 1	x	-	-	-
Line 0	-	-	x	x
Phonemes	ɪn	vɪ	zə	bˤl

Figure 17

Spectrogram of Stress Placement of the word 'Invisible' in RP

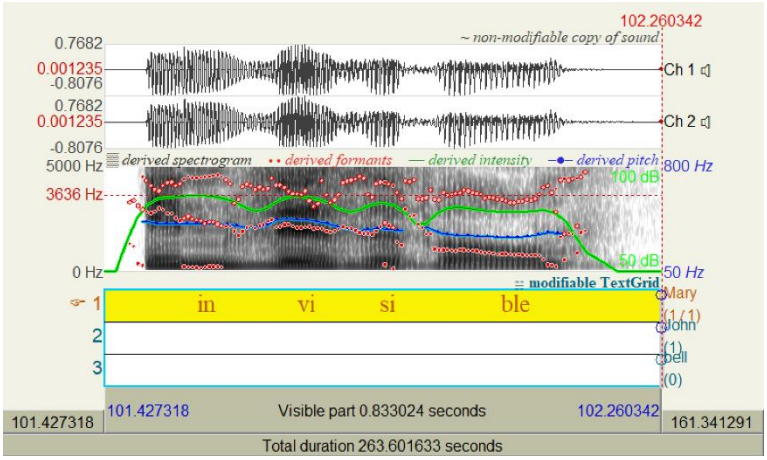


Table 26

Metrical Grid of Stress Placement of the word 'Invisible' in Variant 1

Line 2	-	-	-	x
Line 1	x	-	x	-
Line 0	-	x	-	-
Phonemes	ɪn	vɪ	zə	bᵊl

Figure 18

Spectrogram of Stress Placement of the word 'Invisible' in Variant 1

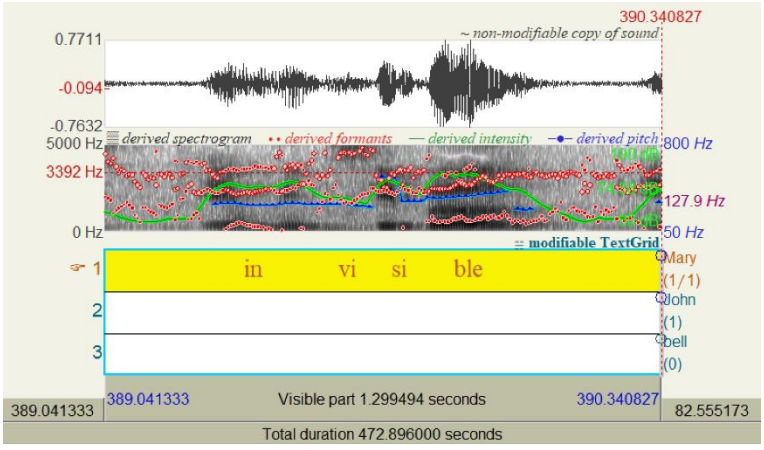


Table 27

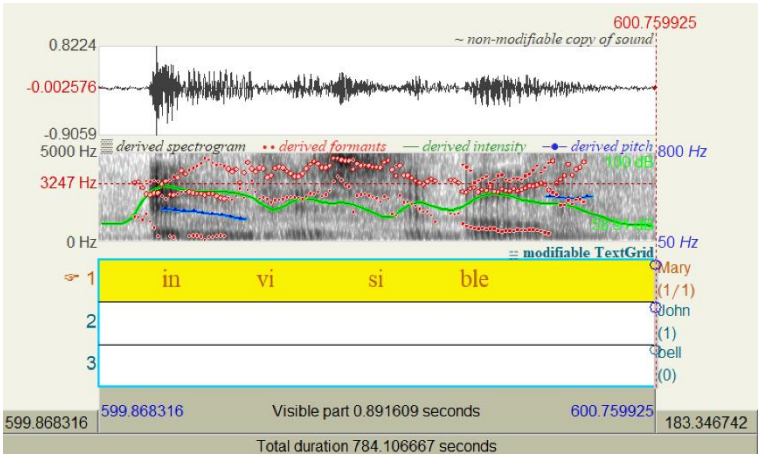
Metrical Grid of Stress Placement of the word 'Invisible' in Variant 2

Line 2	x	-	-	-

Line 1	-	x	-	-
Line 0	-	-	x	x
Phonemes	ɪn	vɪ	zə	bᵊl

Figure 19

Spectrogram of Stress Placement of the word 'Invisible' in Variant 2



4.2.1.8 International

Table 28

Metrical Grid of Stress Placement of the word 'International' in RP

Line 2	-	-	x	-	-
Line 1	x	-	-	-	x
Line 0	-	x	-	x	-
Phonemes	ɪn	tə	næ	ʃᵊ	nᵊl

Figure 20

Spectrogram of Stress Placement of the word 'International' in RP

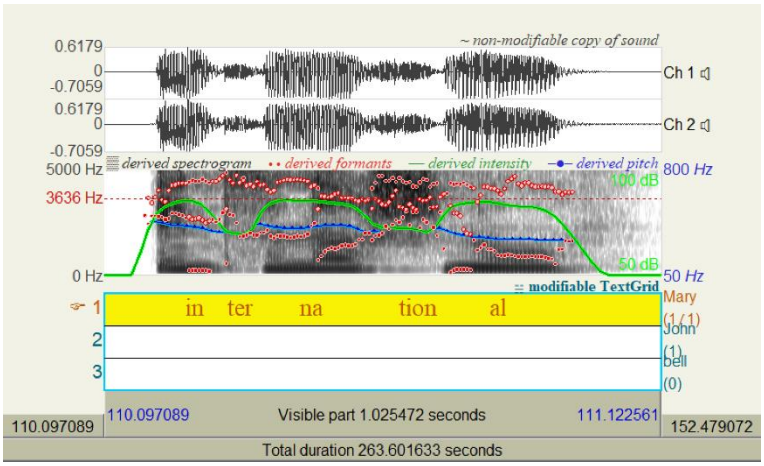


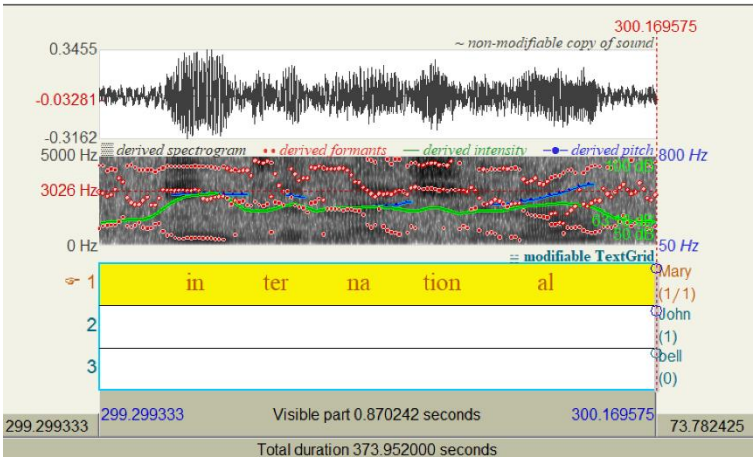
Table 29

Metrical Grid of Stress Placement of the word 'International' in Variant 1

Line 2	x	-	-	-	-
Line 1	-	x	x	x	x
Line 0	-	-	-	-	-
Phonemes	ɪn	tə	næ	ʃᵊ	nᵊl

Figure 21

Spectrogram of Stress Placement of the word 'International' in Variant 1



4.2.1.9 Electricity

Table 30

Metrical Grid of Stress Placement of the word 'Electricity' in RP

Line 2	-	-	x	-	-
Line 1	x	-	-	-	x
Line 0	-	x	-	x	-
Phonemes	ɛ	lɪk	trɪ	sə	ti

Figure 22

Spectrogram of Stress Placement of the word 'Electricity' in RP

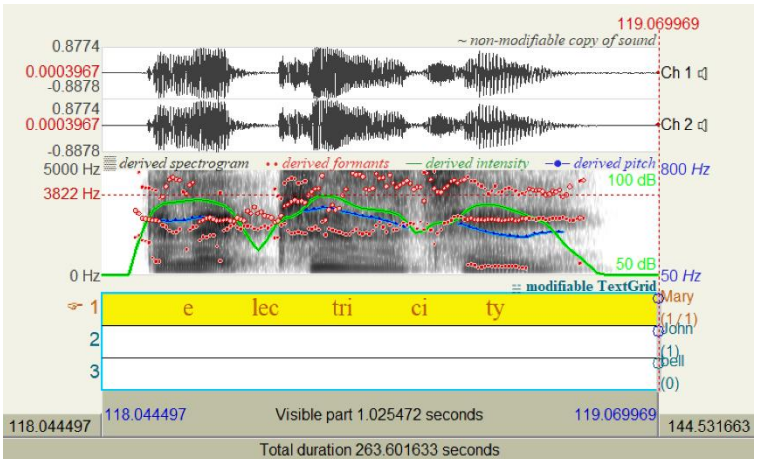


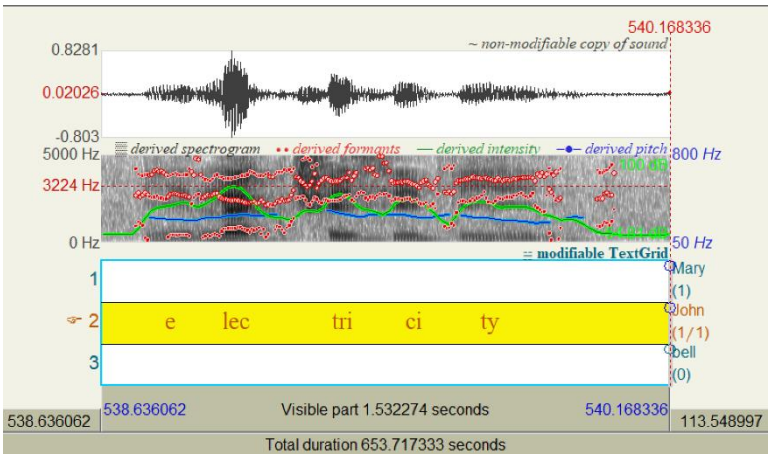
Table 31

Metrical Grid of Stress Placement of the word 'Electricity' in Variant 1

Line 2	-	x	-	-	-
Line 1	x	-	x	-	x
Line 0	-	-	-	x	-
Phonemes	ɛ	lɪk	trɪ	sə	ti

Figure 23

Spectrogram of Stress Placement of the word 'Electricity' in Variant 1



4.2.1.10 Alternative

Table 32

Metrical Grid of Stress Placement of the word 'Alternative' in RP

Line 2	-	-	x	-
Line 1	x	-	-	x
Line 0	-	x	-	-
Phonemes	ɒl	tɜː	nə	tɪv

Figure 24

Spectrogram of Stress Placement of the word 'Alternative' in RP

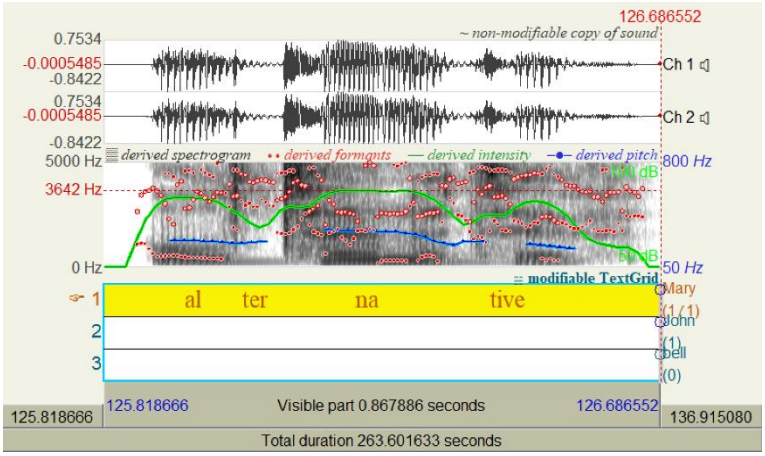


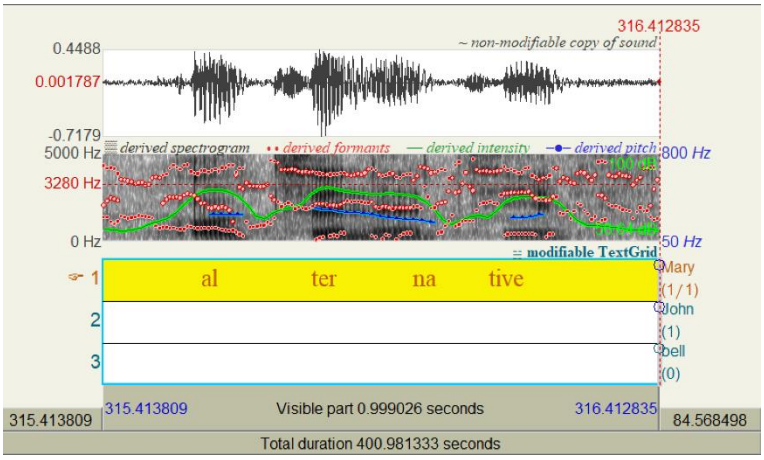
Table 33

Metrical Grid of Stress Placement of the word 'Alternative' in Variant 1

Line 2	-	x	-	-
Line 1	x	-	x	x
Line 0	-	-	-	-
Phonemes	ɒl	tɜː	nə	tɪv

Figure 25

Spectrogram of Stress Placement of the word 'Alternative' in Variant 1



4.2.1.11 Complicated

Table 34

Metrical Grid of Stress Placement of the word 'Complicated' in RP

Line 2	x	-	-	-
Line 1	-	x	x	-
Line 0	-	-	-	x
Phonemes	kɒm	plɪ	keɪ	tɪd

Figure 26

Spectrogram of Stress Placement of the word 'Complicated' in RP

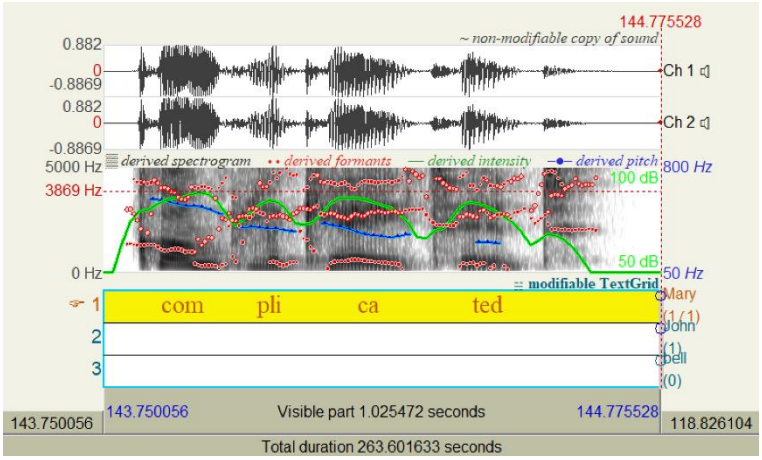


Table 35

Metrical Grid of Stress Placement of the word 'Complicated' in Variant 1

Line 2	-	-	-	-
Line 1	x	x	x	x
Line 0	-	-	-	-
Phonemes	kɒm	plɪ	keɪ	tɪd

Figure 27

Spectrogram of Stress Placement of the word 'Complicated' in Variant 1

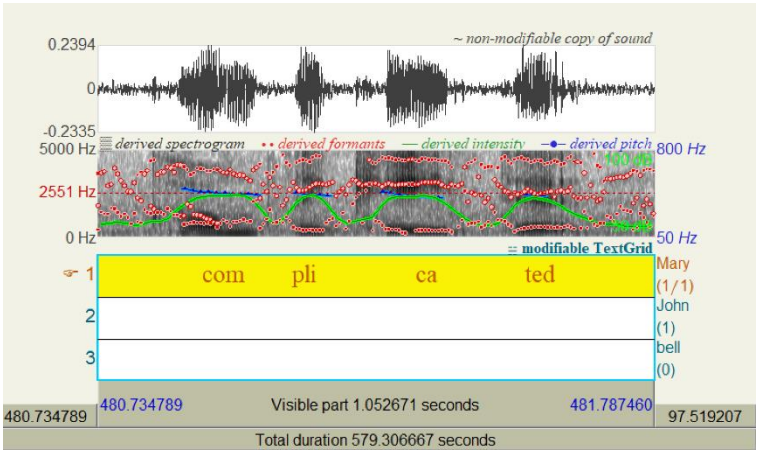


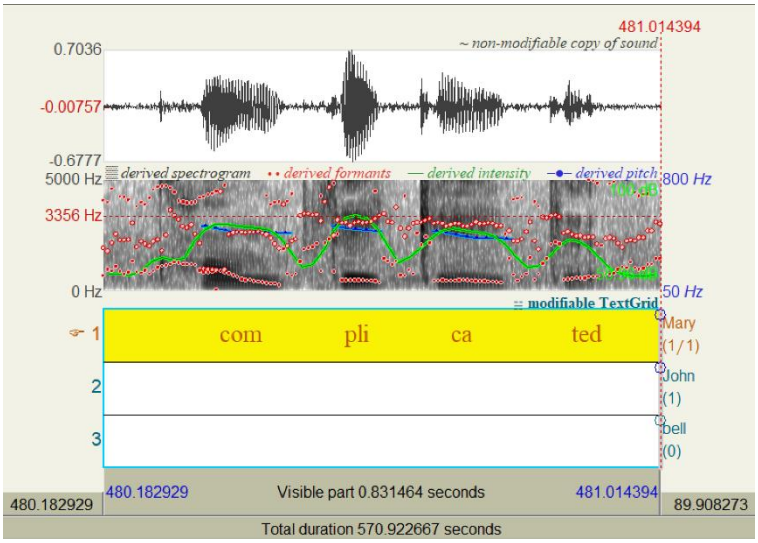
Table 36

Metrical Grid of Stress Placement of the word 'Complicated' in Variant 2

Line 2	-	x	-	-
Line 1	x	-	x	-
Line 0	-	-	-	x
Phonemes	kɒm	plɪ	keɪ	tɪd

Figure 28

Spectrogram of Stress Placement of the word 'Complicated' in Variant 2



4.2.2 Stress variation in compound words

Participants were asked to read a list of 12 compound words in which the main stress was on the first syllable of the word (Appendix 6). Table 37 shows the analysis of pronunciation of compound words in RP along with the variant stress patterns produced by participants.

Table 37

Variant stress patterns produced by participants in reading compound words

Word	IPA Transcription	Stress on	Variant stress	Occurred in

Airport	/eəpɔːt/	/eə/	Stress on /eə/ and /pɔːt/	E2, MC1, MC4, MC6, M3, T2
			Stress on /pɔːt/	E1, E4, E6, MC2, MC3, MC5, M1, M2
Handshake	/hændʃeɪk/	/hænd/	Stress on /ʃeɪk/	E1, E6, MC4, MC6, M1, M3
			Stress on /hænd/ and /ʃeɪk/	E4, MC3, MC5, T2
Firefighter	/faɪəfaɪtə/	/faɪə/	Stress on /faɪə/, /faɪt/, /tə/	E3, E6, MC3, MC6, M1
			Stress on /faɪt/	M2
			Stress on /tə/	MC6
Football	/fʊtbɔːl/	/fʊt/	Stress on /bɔːl/	E1, E3, E6, MC3, MC6, M1, M2, M4, T1, T2
Toothbrush	/tuːθbrʌʃ/	/tuːθ/	Stress on /brʌʃ/	E1, E4, E6, MC2, MC3, MC4, MC5, MC6, M1, M2, T1, T2, T3
Cupcake	/kʌpkeɪk/	/kʌp/	Stress on /keɪk/	E2, MC6, M1, M4, T1, T3

			Stress on /kʌp/ and /keɪk/	MC1, MC3, T2
Grandmother	/grænmʌðə/	/græn/	Stress on /græn/, /mʌ/ and /ðə/	E6, MC3
Butterfly	/bʌtəflaɪ/	/bʌt/	Stress on /flaɪ/	E6, MC1, MC3, MC5, M2, M3, M4, T1, T3
Newspaper	/njuːzˌpeɪpə/	/njuːz/	Stress on /peɪ/	E5
			Stress on /pə/	E6, MC2, MC6, M1, M4, T4
			Stress on /njuːz/, /peɪ/ and /pə/	E1, E4, MC5, T2
Jellyfish	/ʤɛlɪfɪʃ/	/ʤɛ/	Stress on /fɪʃ/	E1, E7, MC2, MC4, MC6
			Stress on /ʤɛ/, /lɪ/ and /fɪʃ/	E6, MC1, MC3
Pineapple	/paɪnæpˑl/	/paɪn/	Stress on /pˑl/	MC1, MC3, MC6, M1, T3
			Stress on /paɪn/, /æ/ and /pˑl/	MC5
Waterfall	/wɔːtəfɔːl/	/wɔː/	Stress on /wɔːtə/ and /fɔːl/	E4, MC3, MC5

			Stress on /fɔːl/	E1, MC1, MC4, M1

4.2.3 Stress variation and presence of tone in sentence reading

Participants were asked to read a list of 4 sentences and 1 conversation (Appendix 7). Most participants demonstrated an accurate production of stress patterns while some failed to provide any stress variation whatsoever. There was also a placement of stress on different words as the participants perceive different words to be more important. Table 38 shows the analysis of the variant stress placement in the sentences produced by participants.

Table 38

Variant phonemes produced by participants in sentence reading

Sentences	Designated words with primary stress placement	Stress and tonal variation	Occurred in
1	Weekend	Absence of stress	E1, E4, MC1, M1
		Stress on ‘not’	MC3
2	Convenience store	Absence of stress	E1, MC1, MC2, MC3, M1
		Stress on ‘not’	E5, E6, MC6
3	Evening	Absence of stress	E1, E4, MC1, MC2, MC3, M1
		Stress on ‘not	E6

4	Sarah	Absence of stress	E1, MC1, MC3, M1
5	Bought	Absence of stress	E6, MC1, MC5, MC6, M1
		Stress on questions	MC2, MC3, MC4, T2, T4
		Stress on ‘about	M3
	Book	Absence of stress	E4, E6, MC1, MC2, MC5
		Stress on questions	E7, MC2, MC3, MC4, MC6, T3, T4
		Stress on ‘about’	E5, M3, T2
	Caterpillars	Absence of stress	E4, E6, MC1, MC2, MC5, M1
		Stress on questions	E7, MC2, MC3, MC4, MC6, T3, T4
		Stress on ‘about’	E5, M3, T2

4.3 Executive Functioning in Bilinguals and Multilinguals

After completing the reading test, the two tests on executive functioning, Simon test and Stroop test, were conducted with each of the participants on the researcher’s laptop. The tests began with the researcher explaining the instructions verbally to the participant, then the formal instructions from the test were displayed for the participant to read and further understand on their own. Any questions or confusion from the participants were addressed to ensure that they understood the concept of the tests. Majority of the participants showed some hesitation and made some mistakes in the beginning of both tests due to the unfamiliar nature of the tests, but they

managed to adapt and complete both tests without any issues. After completing these two tests, the participants were informed that the research interview had ended and were thanked for their time.

4.3.1 Simon Effect

Overall, the participants found the Simon test relatively easier to get used to and were able to complete the test with little to no issues. The Simon test requires participants to respond to the words ‘LEFT’ and ‘RIGHT’ that were displayed on the screen with the ‘A’ key on the left-side of the keyboard for the word ‘LEFT’ and the ‘L’ key on the right-side of the keyboard for the word 'RIGHT’. However, the word ‘LEFT’ may appear on the right side of the screen (Appendix 10) while the word ‘RIGHT’ may appear on the left side of the screen, creating an incompatible condition as opposed to a compatible condition in which the word corresponds with its position on the screen. Thus, the Simon test serves to test the stimulus-response compatibility effect of the participants in which it is assumed that the incompatible condition will elicit a slower response. However, this is not the case in this study as some participants show faster average response times for incompatible conditions compared to compatible conditions. The Simon effect is calculated by subtracting the average incompatible scores from the average compatible scores.

Table 39

Compatible, incompatible and Simon effect scores of participants with their language group and demographic characteristics

Group	Age	Economic Status	Compatible Scores (ms)	Incompatible scores (ms)	Simon Effect (ms)
Multilingual	22	B40	661	630	-31

Multilingual	22	M40	705	757	52
Multilingual	26	B40	575	509	-66
Multilingual	22	B40	775	539	-236
Multilingual	22	M40	714	571	-143
Multilingual	51	T20	609	589	-20
Multilingual	22	M40	611	671	60
Multilingual	22	M40	612	597	-15
Multilingual	23	M40	602	562	-40
Multilingual	36	T20	623	574	-49
Multilingual	24	B40	606	520	-86
Multilingual	21	B40	609	553	-56
Multilingual	23	B40	880	934	54
Multilingual	22	B40	592	637	45
Multilingual	22	B40	720	770	50
Bilingual	22	M40	434	578	144
Bilingual	24	M40	604	575	-29
Bilingual	21	M40	609	513	-9

Bilingual	22	B40	574	557	-17
Bilingual	38	M40	828	943	115
Bilingual	35	M40	611	741	130
Mean value (x̄)			**645.43**	**610.48**	**-7.00**

4.3.2 Stroop Effect

Overall, the participants found the Stroop test more difficult to adapt to but were able to complete the test successfully. The Stroop test displayed four different words which were 'RED', 'GREEN', 'BLUE', and 'YELLOW' in which the print color of the word would differ. For example, the word 'YELLOW' would appear in the print color red (Appendix 11) in which participants would need to respond to the print color and not the meaning of the word by pressing the corresponding keys 'R' for red in this case, and 'G' for green, 'B' for blue, and 'Y' for yellow for the relevant stimuli. A congruent condition is formed when the meaning of the word corresponds with the print color such as the word 'GREEN' in the color green while an incongruent condition is when the meaning of the word does not correspond with the print color. The Stroop test also serves to test the participants stimulus-response congruent effect, and it is assumed that an incongruent condition will elicit a slower response. This can be observed in majority of the participants other than the few who tend to show a slightly better average response in incongruent conditions.

Table 40

Compatible, incompatible and Stroop effect scores of participants with their language group and demographic characteristics

Group	Age	Economic Status	Congruent Scores (ms)	Incongruent Scores (ms)	Stroop Effect (ms)
Multilingual	22	B40	911	1051	140
Multilingual	22	M40	1234	1270	36
Multilingual	26	B40	1032	968	-64
Multilingual	22	B40	871	991	120
Multilingual	22	M40	913	902	-11
Multilingual	51	T20	912	1369	457
Multilingual	22	M40	862	906	44
Multilingual	22	M40	1197	1112	-85
Multilingual	23	M40	683	783	100
Multilingual	36	T20	895	957	62
Multilingual	24	B40	967	1013	46
Multilingual	21	B40	896	939	43
Multilingual	23	B40	943	1052	109
Multilingual	22	B40	695	865	170
Multilingual	22	B40	940	901	-39
Bilingual	22	M40	796	786	-10

Bilingual	24	M40	721	846	125
Bilingual	21	M40	1259	1154	-105
Bilingual	22	B40	880	841	-39
Bilingual	38	M40	1296	1282	-14
Bilingual	35	M40	912	1106	194
Mean value (x̄)			**943.57**	**1004.48**	**60.90**

4.3.3 Phonological Interference and its correlation to executive functioning

As this study aims to identify and understand whether there is a correlation between the prevalence of phonological interference in the participants and their executive functioning in terms of Simon effect and Stroop effect scores, the total variants displayed by each individual participant are accumulated and compared with their executive functioning test scores in Table 41.

Table 41

Total variants, Simon effect and Stroop effect scores of each participant

Participants	Total variants	Simon Effect (ms)	Stroop Effect (ms)
E1	18	31	140
E2	5	144	-10
E3	3	-66	-64
E4	19	-236	120

E5	10	52	36
E6	24	-9	-105
E7	6	-29	125
MC1	29	-143	-11
MC2	21	-17	-39
MC3	36	-20	457
MC4	22	60	44
MC5	26	-15	-85
MC6	32	-40	100
M1	29	115	-14
M2	12	-49	62
M3	17	130	194
M4	16	-86	46
T1	13	54	109
T2	15	-56	43
T3	14	45	170
T4	15	50	-39

In order to further understand the relation between executive functioning and the prevalence of phonological interference, this study will compare the number of variants to the

Simon Effect and Stroop Effect scores in which the variants are categorized as Group 1 portraying 0 to 10 different phonological variants, Group 2 displaying 11 to 20 phonological variants, Group 3 with 21 to 30 phonological variants and Group 4 showing 31 and above phonological variants.

4.4 Interlanguage of participants

4.4.1 Participants' self-reported language experience and proficiency

Before starting the reading test, participants were asked to fill in a revised version of the Language Experience and Proficiency Questionnaire (LEAP-Q) in order to better understand the participants, experience and proficiency in their dominant language and other acquired languages. This questionnaire is crucial in determining whether the participants' interlanguage is fully developed or not by comparing their language profile to the prevalence of phonological interference individually. Participants were asked to state the duration of exposure to English in their country, family as well as school or working environment, age of acquisition and fluency in terms of speaking and reading the language as well as the most important contributor in learning English from the options of interacting with friends, interacting with family, watching television (TV), listening to radio or music, reading and languages tapes or self-instruction. In the table below, the categories of ''country', 'family', and 'school or working' environment in terms of exposure to English are represented by 'C', 'F', and 'S/W' each; while speaking, reading and understanding spoken language are known as 'S', 'R', and 'U' respectively.

Table 42

Participants' self-reported duration of exposure to English, age of acquisition and fluency, and most important contributor in learning English along with the total variants observed in reading test

Participant	Duration of exposure to English (years)			Age of acquisition (years)		Age of fluency (years)		Most important contributor in learning English	Total variants
	C	F	S/W	S	R	S	R		
E1	22	22	17	3	7	7	8	Watching TV	18
E2	22	22	19	2	3	7	7	All	5
E3	26	26	23	2	2.5	3.5	3.5	Interacting with family, reading	3
E4	22	22	18	2	6	3	6	Interacting with family	19
E5	22	22	16	3	4	8	8	Watching TV	10
E6	21	21	16	3	4	7	8	Interacting with friends and family, listening to music/radio	24
E7	24	24	21	1	3	5	5	All	6
MC1	22	0	18	4	7	7	8	Interacting with friends, watching TV, listening to	29

								music/radio, reading	
MC2	22	0	18	4	4	8	10	Interacting with friends, watching TV, listening to music/radio reading	21
MC3	51	30	45	8	8	20	21	Interacting with friends and family, watching TV	36
MC4	22	0	19	3	5	5	5	Interacting with family and friends, reading	22
MC5	22	0	14	8	7	10	7	Listening to music/radio, reading, language/self-instruction tapes	32
MC6	13	0	17	4	4	18	12	Watching TV, listening to music/radio, language/self-instruction tapes	32

M1	38	0	32	4	6	5	7	Interacting with friends, watching TV, listening to music/radio	29
M2	36	0	22	4	5	7	8	Watching TV, listening to music/radio, reading, language/self-instruction tapes	12
M3	35	35	30	5	7	7	8	Interacting with family, listening to music/radio	17
M4	24	0	19	5	7	7	7	Interacting with friends, Watching TV, listening to music/radio, reading	16
T1	23	23	21	2	4	5	6	Interacting with family and friends, watching TV, reading	13

T2	21	21	18	2	4	4	5	Watching TV, listening to music/radio, reading	15
T3	22	22	13	2	3	10	10	All	14
T4	22	0	18	5	6	7	7	Interacting with friends, watching TV, listening to music/radio, reading	15

Chapter 5
Discussion and Conclusion

5.1 Comparisons between English, Mandarin Chinese, Malay and Tamil phonology

As the variants produced by the participants will be analyzed according to influence from their L1 phonemic systems as well as their interlanguage system, this section will discuss significant features of English, Mandarin Chinese, Malay and Tamil phonology.

Firstly, in terms of consonants, English consists of 24 consonants, Mandarin Chinese 25 while Malay and Tamil have lesser consonants of 19 and 16 respectively (Phoon et. al., 2013). One of the main distinctions between these languages are the prominence of different consonants in syllable-initial and syllable-final positions which contributes to the prevalence of phonological interference when pronouncing English words as the other three languages have significantly different and lesser consonants used specifically in onset and coda positions (Appendix 12). Consonants in English that exist in Mandarin Chinese, Malay and Tamil can also have a different way of pronunciation (Appendix 13, 14, 15). Furthermore, Mandarin Chinese and Malay practice a strict syllabic system in which only one consonant is allowed before and after a vowel, indicating a C-V-C system whereas Tamil allows a maximum of two consonants while English allows three consonants before a vowel and four consonants after (Phoon et. al., 2013).

Next, in terms of vowel differences, it is observed that Mandarin Chinese (Odinye, 2020) and Malay (Hua et. al. 2011) do not provide any distinction between long and short vowels but it is an existing feature of Tamil vowels (Appendix 16, 17, 18). There are also no diphthongs in the Malay vowel inventory (Hua et. al., 2011) but both Mandarin Chinese and Tamil account for quite a number of diphthongs in which some may differ from the English pronunciation (Appendix 19). Additionally, Malay uses the same Latin-based alphabetic script as English but differs in the sense

that it has a significantly higher degree of orthographic transparency, indicating almost one-to-one correspondence between phonemes and graphemes (Winskel, 2020). On the other hand, Tamil is known as having an alphasyllabary orthography in which it is neither alphabetic nor syllabic but also has a fairly transparent orthography (Winskel, 2020). It is also important to note that Tamil does not share the same characteristics as other Indic languages. Lastly, for Mandarin Chinese, there is no connection between the logographic system used and the phonetic symbols used to transcribe Western languages which leads to the usage of Pinyin, a Romanized system that translates the Mandarin Chinese sounds in place of IPA transcriptions and is not considered a 'real' phonetic transcription system (Winskel, 2020).

Regarding suprasegmental features, it was found that there was very little literature on stress patterns in Malay (Setter et. al., 2019) and Tamil (Narasimhan, 2010) while the debate on stress placement in Mandarin Chinese has been a focus of debate for a long time (Hsieh, 2021). However, the existing studies on these three languages often produce contradictory results (Vinton, 2024) which makes it difficult for this study to analyze the occurrences of suprasegmental variants due to influence from L1. It was observed that most accounts agree that Malay phonology places stress on the penult of a word or syllables with CVC structure (Don et. al., 2008) while Tamil phonology favors stress on heavy syllables with a long vowel, VC, or VCC syllabic structure (Pingali, 2009). Conversely, Mandarin Chinese is a tonal language and does not practice the use of stress to provide distinctions or give lexical meaning to syllables (Odinye, 2020). Nonetheless, English stress placement can still be affected by the Mandarin Chinese tones in which the first tone produces high but steady level tone; the second tone also produces a high tone but is considered rising; the third tone is observed with a falling and rising tone all in one syllable; and the final tone contains a falling tone only (Odinye, 2020). Next, stress placement errors can also occur in levels

higher than the word such as in sentences as will be covered in this study as well. While stress placement errors within phrases are said to occur less frequently, they are prominent with the same obviousness as lexical stress errors (Cutler, 1980). Errors in sentence stress placement are usually the consequence of independent errors from the speaker themselves such as a shift in grammatical marking or degree of importance (Cutler, 1980) and not particularly due to difference in the L1 phonological system.

5.2 Discussion of types of segmental interference present in different multilingual groups in Malaysia

5.2.1 Underdifferentiation

Weinreich (1957) has referred to it as when a speaker of another language analyses the fricativity of an intervocalic English as redundant. In this study, the participants involved are either English-, Mandarin Chinese-, Malay-, or Tamil-dominant in which underdifferentiation would refer to the participant perceiving a sound in English to be redundant because that sound is not used or does not exist in their dominant language, causing underdifferentiation due to influence from their L1.

5.2.1.1 Variant /ɪ/

Firstly, the highest-occurring variant classified as underdifferentiation is the variant of /ɪ/ as a high front lax vowel from the target phoneme of /i:/ as a high front tense vowel. A total of two English-dominant speakers, five Mandarin-Chinese dominant speakers, three Malay-dominant speakers, and one Tamil-dominant speaker displayed this variant in their speech during the minimal pairs task in the word ‘sheep’ and ‘beat’.

Out of six Mandarin Chinese-dominant speakers, five exhibit this variant. this is because the difference between tense and lax vowels do not exist (Odinye, 2022) which causes the Mandarin Chinese-dominant speakers to associate the long vowel /i:/ with the short vowel /ɪ/. In Pinyin, the vowel 'i' will be pronounced as the short vowel /ɪ/ and vowels are usually differentiated by tones, not length (Odinye, 2022). This shows a negative transfer from the L1 as Mandarin Chinese perceives distinction in vowel lengths as redundant.

The reason for this interference in Malay-dominant speakers is that there is no distinction between tense and lax vowels in Malay. As orthographic transcription of a word directly corresponds with its phonetic feature in Malay (Winskel, 2020), the spelling of 'ship' is directly assumed to be pronounced as /ɪ/ in Malay-dominant speakers.

For the English-dominant speakers, this variant may have stemmed from influence from their second language which is Malay despite their dominant language being English. It can be assumed that these two speakers produce this variant not only because of influence from their second language in which there is no contrast between short and long vowels, but also because their interlanguage is underdeveloped, causing them to be the only ones producing this variant among the other English-dominant speakers whose second language is Malay.

Lastly, only one Tamil-dominant speaker out of the four in this study produced this variant. However, Tamil phonology shows a clear distinction in short and long vowels as similar to English (Kanapathy, 2015). Thus, the possible reason for this interference is influence from the Malay language as well, however as Malay is this speaker's third language while English is their second, it is more appropriate to assume that this interference occurs because of a fossilized interlanguage compared to influence from another language. Thus, this causes the speaker to place the high front lax vowel, /ɪ/ and the high front tense vowel, /i:/ in the same category.

5.2.1.2 Omission of sounds /ø/

Next, there have been three accounts of omission of sounds among the Mandarin Chinese- and Malay-dominant speakers when the target phoneme was supposed to be voiceless velar plosive /k/, voiceless dental fricative /θ/, and voiced retroflex approximant /ɻ/.

It can be observed that the Mandarin Chinese-dominant speakers only produced one variant of omission of sounds, and it was when the target phoneme was the voiced retroflex approximant, /ɻ/ which was observed in five out of six of the Mandarin Chinese-dominant speakers. This variant occurs in the dialogue reading task in words such as 'librarian', 'secretary, and 'library' in which the /ɻ/ sound is regarded as redundant and thus omitted by speakers despite this sound existing in Mandarin Chinese (Odinye, 2022). However, this variant is still attributed to influence from Mandarin Chinese as the speakers' dominant language because there are no consonant clusters in Mandarin Chinese with syllables typically being a maximum of C-V-C (consonant-vowel-consonant) (Phoon et. al., 2013). This causes the speakers to simplify the consonant cluster of /bɻ/ by omitting the /ɻ/ sound. It can also be assumed that due to the lack of L1 template for this consonant cluster, the speakers' fossilized interlanguage repairs this absence by referencing the phonemic system of Mandarin Chinese and drops the /ɻ/ sound.

For Malay-dominant speakers, there were three different target phonemes that were replaced by omission on sound. Firstly, the voiceless velar plosive /k/ was omitted in the free conversation task by one out of four Malay-dominant speakers as seen when saying the phrase 'like that'. As /k/ is typically used as onset and not coda in Malay, the speaker may have simplified it to fit the Malay phonemic system, causing the /k/ sound to be omitted altogether. Furthermore, as the phrase 'like that' was used during free conversation, the rapid speech usually will cause resyllabification, which is the repositioning of syllables (Roelofs, 2000), to occur in which the

coda /k/ of ‘like’ would have been repositioned to be the onset of ‘that’, creating a complex consonant cluster of /kt/. As consonant clusters do not exist in Malay as well (Phoon et. al., 2014), the speaker’s interlanguage would have dropped the /k/ phoneme as to not violate Malay phonotactic rules.

The next omitted phoneme exhibited by two out of four Malay-dominant speakers is the voiceless dental fricative /θ/ which was also observed in free conversation in the word ‘strength’ where the /θ/ sound exists as a consonant cluster of /ŋθ/. This omission can be explained by the fact that the /θ/ sound does not exist in the phonology of Malay and due to the absence of consonant clusters Phoon et. al., 2014). Additionally, the phoneme /ŋ/ in Malay is actually commonly used as coda (Phoon et. al., 2014) which caused the speakers’ fossilized interlanguage to address the unfamiliar consonant cluster by dropping the /θ/ sound and retaining the /ŋ/ phoneme only as the coda similarly in Malay words.

Lastly, the voiced retroflex approximant, /ɻ/ was also observed to be omitted by two out of four Malay-dominant speakers in the same conditions as the Mandarin Chinese-dominant speakers. As mentioned above, the consonant clusters such as /cr/ and /br/ in the targeted words ‘secretary’, ‘librarian’, and ‘librarian’ do not exist in Malay despite the /ɻ/ sound existing in Malay phonology, causing the speakers’ interlanguage to adhere to their L1’s phonotactic rules to address the complexity of the consonant clusters by dropping the /ɻ/ sound entirely.

5.2.1.3 Variant /s/

The last variant categorized as underdifferentiation is the voiceless alveolar fricative /s/ in the place of the target voiceless velar plosive /k/ which was observed in two Mandarin Chinese- and one Malay-dominant speaker. This variant was observed in free conversation when producing

the word ‘success’. All three speakers appeared to omit the /k/ sound and reemphasized the /s/ sound to become /səsɛs/ instead of /səksɛs/.

The omission of the /k/ sound is presumed to be due to the absence of /k/ as a coda in the syllable /sək/ in both Mandarin Chinese and Malay while the reemphasizing of /s/ may be an attempt of the speakers’ to replace the omitted /k/ sound as it is the onset of the syllable /sɛs/ in which the the /s/ sound is often used as a syllable-initial consonant in Mandarin Chinese and Malay (Phoon et. al., 2013). Furthermore, as /k/ is a plosive consonant, it requires a complete closure in the vocal tract before opening suddenly to release pressure built up behind the constriction at the place of articulation (Alwan et. al., 2011), which can be considered more difficult to produce compared to /s/ as a fricative consonant which only requires continuous airflow while constricting the vocal tract (Alwan et. al., 2011). That said, it can be concluded that all three speakers’ underdeveloped interlanguage complied with the phonotactic constraints of their L1 and simplified the consonant clusters by omitting the supposedly more difficult consonant /k/.

5.2.2 Overdifferentiation

Weinreich (1957) classifies overdifferentiation as when a speaker identifies a feature of sound to be distinctive in which is redundant in the original language. As the participants are categorized according to their dominant language, variants under overdifferentiation are observed when the participant views a sound in their L1 to be necessary and contrastive and uses it when pronouncing English words but is actually redundant in English. This category of interference has been observed to be the lowest-occurring type of phonemic interference throughout the study and did not occur in any English-dominant speakers.

5.2.2.1 Redundant schwa /ə/

There have been three different target phonemes that were inaccurately pronounced by speakers due to a redundant schwa /ə/. This occurrence can be attributed as epenthesis which is characterized as occurring in marked clusters and they usually act as the nucleus to repair a syllabic structure that violates the phonotactic rules of the speakers' L1 (Kim et. al., 2024).

Firstly, the variant observed was voiced alveolar plosive /t/ succeeded with a schwa to produce /tə/ in which the schwa was redundant, and it occurred in the word 'strength' during the free conversation task to produce /stərɛŋθ/ instead of /strɛŋθ/. This variant was only produced by one Tamil-dominant speaker and the schwa can be explained as an epenthetic vowel used to break up the complex consonant cluster of /str/ in /strɛŋθ/. As Tamil phonotactic rules only allow a maximum of two consonants before and after a vowel nucleus (CCVCC), the speaker inserts a schwa intentionally to act as a nucleus after two consonants of /st/ due to influence from L1 phonotactic rules. The fact that only one Tamil-dominant speaker out of four displayed this variant also shows the difference in their interlanguage development, signifying that this speaker's interlanguage underwent fossilization much early and did not receive any phonemic correction.

The second redundancy of schwa was identified in the voiced alveolar lateral approximant /l/ that was followed by a schwa to show the variant /lə/ in the word 'film' during the free conversation task and word list task. Two Mandarin Chinese-dominant speakers and one Malay-dominant speaker displayed this variant in which the epenthetic schwa can be seen as a nucleus to break up the consonant cluster of /l/ in /fɪlm/ as both Mandarin Chinese and Malay strictly follow the syllable structure of CVC to produce the variant /fɪləm/ (Phoon et. al., 2013). Furthermore, while the word 'filem' exists as the Malay word for 'film', other Mandarin Chinese-dominant and Malay-dominant speakers have not displayed traces of this specific variant. This leads to the

assumption that the three targeted speakers here have not experienced full development of their interlanguage compared to members of their language groups and cause them to adhere to the CVC rules of their L1 and produce the more familiar and easier version of the word ‘film’.

Thirdly, the variant /bə/ occurred due to the voiced bilabial plosive /b/ paired with a redundant schwa. This variant was not observed in Malay-dominant speakers but in two Mandarin Chinese and Tamil-dominant speakers in the word ‘terribly’ pronounced incorrectly as /tɛrəbəli/ instead of /tɛrəbli/. The reason behind this occurrence is also similar to that of the previous two examples in which Mandarin Chinese strictly follows the CVC syllable structure (Phoon et. al., 2013), causing the speakers to insert the redundant schwa as to not violate their L1’s phonemic system. However, Tamil occasionally exhibits the CCVCC structure such as in the final syllable of ‘terribly’ despite typically favoring the CVC structure as well (Phoon et. al., 2013). This variant occurring in Tamil-dominant speakers can be better explained by the fact that Tamil is a ‘fairly transparent orthography’ (Winskel, 2020), indicating that each letter typically translates directly to its designated phonemic sound. Thus, as the final syllable of ‘terribly’ does not contain any written vowel to act as nucleus whatsoever despite the final syllable pronounced as /bli/ with the vowel /i/, Tamil speakers may directly view the letter ‘y’ as the sound /j/ at first glance and their underdeveloped interlanguage may cause them to switch to the rules of their L1 by inserting a schwa to break up the illicit consonant cluster of ‘bly’ even though the syllable technically follows a CCV structure.

5.2.2.2 Variant /kʰ/

Another variant produced by participants as overdifferentiation is the aspirated voiceless velar plosive /kʰ/ in the place of voiceless velar plosive /k/. This was only seen once in the word ‘music’ where the /k/ sound was emphasized more than needed by one Tamil-dominant speaker

during the free conversation task. However, Tamil does not have any aspirated consonants unlike most Indic languages (Kanapathy, 2015) while English is an aspirating language in which Indic languages have been consistently adapting aspirated English phonemes as unaspirated (Narkar, 2021), which contradicts the occurrence of this variant produced by a Tamil-dominant speaker. The first explanation for this phenomenon can be due to the strict rules for voicing of plosives in 'centamil' which is known as 'pure' Tamil (Kanapathy, 2015) in which voiced plosives can become fricatives intervocalically. In the /kʰ/ sound, the aspiration is a short puff of air than can resemble a soft fricative /h/ despite not articulated at the glottis which can tie this variant to the speaker's interlanguage following the plosive rules of 'centamil' even though aspiration does not exist in Tamil. Another possible reason can be because the speaker intended to emphasize their perceived correctness of the word and produced an unnecessary aspiration of the /k/ sound despite aspiration in English only occurring when the plosive sound is at the onset position (Narkar, 2021). This confusion also points to the fossilization of the speaker's interlanguage as they are not able to perceive the correct position in English to produce aspiration.

5.2.2.3 Variant /k/

The last overdifferentiated variant is the voiceless alveolar fricative /s/ being inaccurately preceded by the voiceless velar plosive /k/. Only Mandarin Chinese-dominant speakers were observed to produce this variant on two different accounts, one in the word 'sci-fi' during the free conversation task and one in the word 'electrician' in the dialogue reading task. The extra /k/ sound in both targeted words are seen to be used to replace 'c' letter to become /skaɪfaɪ/ and /ɪlɛktrɪkʃən/. As Mandarin Chinese utilizes the logographic system which cannot be transcribed using the typical phonemic symbols for Western languages (Odinye, 2022), this study will refer to the 'Pinyin' which is a Romanized system that represents Mandarin Chinese sounds more conveniently. In

Pinyin, the letter ‘c’ translates into the IPA transcription of /tsʰ/ and not /s/ (Odinye, 2022) but is only seen as the onset of a syllable (Phoon et. al., 2013). This makes it difficult for the speakers to project the L1 phonemic rules of the letter ‘c’ on the two target words as they occur in a consonant cluster that is absent in Mandarin Chinese. Consequently, the speakers choose the /k/ sound that exists in Pinyin to portray the letter ‘c’ as this letter is presented as the /k/ sound in English words such as ‘cow’ and ‘cat’. This phenomenon can be explained by a fossilized interlanguage as the letter ‘c’ only exists as a /k/ sound in their English mental lexicon, showing a lack of exposure to the target language.

5.2.3 Reinterpretation of differences

According to Weinreich (1957), the reinterpretation of differences is produced when speakers project the phonemic rules of their L1 onto the target language, which is English in this study, by classifying a distinctive feature as redundant or vice versa:

> If in a language S a certain distinctive feature is associated with great regularity with a certain redundant feature (e.g. backness and lip-rounding of [u]), and if another language, P, manifests the same association except that the classification of the two features as distinctive and rendundant is reversed, the two sounds may be effectively identified astraddle of the languages, producing an elementary case of reinterpretation of features. (p.6)

This phonemic interference is different from underdifferentiation or overdifferentiation as it does not omit any distinctive features or produce any redundant features from English, but it reverses the characteristic of ‘distinctive’ and ‘redundant’ of a phoneme in English. The reinterpretation of differences is also observed to be the highest-occurring interference in this study.

5.2.3.1 Variant /t/ and /f/

Both variants /t/ and /f/ were produced in place of the target phoneme /θ/ as a voiceless dental fricative. Firstly, as the most prominent variant classified as reinterpretation of differences, the variant /t/ occurred in five out of seven English-dominant speakers, all six Mandarin Chinese-dominant speakers, three out of four Malay-dominant speakers and three out of four Tamil-dominant speakers. It was identified in words such as 'thing', 'strength' and 'Cathay' as onsets and codas throughout all four verbal tasks. According to Phoon et. al. (2013), the phoneme /θ/ only exists in the English phonology and not in Mandarin Chinese, Malay or Tamil at all. This causes the Mandarin Chinese-, Malay- and Tamil-dominant speakers to view the /θ/ sound as redundant and replace it with a distinctive sound in their L1 which is the/t/ sound. Regarding the English-dominant speakers, the occurrence of this variant can be explained by the influence of their L2 on their interlanguage as the targeted speakers all have different L2s of Mandarin Chinese, Malay and Tamil. This shows that the interlanguage of the affected speakers is still not fully developed, despite some of the participants displaying very minimal variants.

On the other hand, the variant /f/ is also selected by English-, Mandarin Chinese- and Tamil-dominant speakers to replace the target phoneme /θ/ in words like 'Ruth' and 'mouth' in the dialogue reading, word list and minimal pair tasks. It is worth noting that the variant /f/ only occurs when the target /θ/ is placed in the coda position. Despite several speakers selected the /t/ variant to replace the /θ/ phoneme in coda positions as mentioned above, the /t/ phoneme actually does not typically exist as a syllable-final consonant or a coda in Mandarin Chinese and Tamil, which can be an explanation why this variant is not observed in Malay-dominant speakers as the /t/ phoneme is prominent as a syllable-final consonant. Moreover, as /t/ is a plosive consonant and requires comparatively more effort to produce compared to a fricative like /f/ (Alwan et. al., 2011)

as mentioned previously, which leads the speakers' interlanguage to replace the /θ/ phoneme with another phoneme that exists in their L1's phonemic rules but also the phoneme that is easier to produce which is /f/.

5.2.3.2 Variant /d/ and /t/

Next, the voiced dental fricative phoneme /ð/ was seen to be reinterpreted as two different variants of /d/ and /t/. Starting with the variant /d/, it was produced by five Mandarin Chinese-dominant speakers, 3 Malay-dominant speakers, and 3 Tamil-dominant speakers in words like 'the' and 'this' that were used throughout the free conversation task and dialogue reading task. The reason of this variant's occurrence is similar to that of the /θ/ phoneme as the /ð/ sound does not exist in the consonant inventory of Mandarin Chinese, Malay or Tamil, causing it to become redundant in adherence to the rules of the speakers' L1. As a result, speakers will resort to a distinctive sound that already exists in their L1 to replace the /ð/ phoneme, which is the /d/ sound that is a prominent consonant in all three languages (Phoon et. al., 2013). In terms of manner of articulation, there are no dental phonemes in Mandarin Chinese and Malay (Phoon et. al., 2013) in which the unfamiliar sound may cause them to hesitate between ending the sound behind the teeth or at the alveolar ridge for /d/ (Jongman et. al., 1985) despite the letters 'th' hinting at a dental sound. On the contrary, Tamil consists of two dental sounds that are commonly used which are /t/ and /d/ but these two sounds can be interchanged, leading to the confusion of the speakers' interlanguage. Ultimately, a fossilized interlanguage will cause the speakers to choose the familiar sound /d/ compared to one that does not exist in their interlanguage which is /ð/.

Similarly, as speakers will resort to a distinctive sound that already exists in their L1 to replace the /ð/ phoneme, the /t/ sound that is prominent in all three languages as a syllable-initial consonant (Phoon et. al., 2013) is also selected by one Mandarin Chinese-speaker when

pronouncing the word ‘with’ in the minimal pair task. The act replacing the /ð/ sound with the /t/ phoneme is a more natural and easier way of articulating the words for these speakers as their L1 already contains a few plosive consonants that are often used, causing their interlanguage to instinctively revert to the L1’s consonant inventory when facing an unfamiliar and significantly trickier sound.

5.2.3.3 Variant /r/

Moving to the next variant of the voiced post-alveolar trill /r/ exhibited in place of the voiced post-alveolar approximant, also represented by the transcription of /r/ and this is observed in two Tamil-dominant speakers in the words ‘right’ and ‘extroverted’ during the free conversation tasks. As the /r/ in both words exist as an initial consonant and in a consonant cluster, it is supposed to be realized as post-alveolar approximants (Phoon & Maclagan, 2009). According to Britannica (n.d.), a trill is produced when the articulators such as the tongue tip and blade, the uvula, and the lips are positioned close to each other and is set into vibration by the airstream. As seen in Rajandran and Hamid (2023)’s research, the phoneme /r/ exists as an alveolar tap or trill instead of a post-alveolar approximant, causing them to map this influence from their L1 onto their speech production in English. Traces of a fossilized interlanguage is evident in these two Tamil-dominant speakers as their pronunciation of /r/ varies between the standard post-alveolar approximant and the variant alveolar trill.

5.2.3.4 Variant /b/ and /g/

For the variants /b/ and /g/, they are assumed to mainly stem from confusion of the speakers and fossilized interlanguage and not entirely from L1 influence. This is because English-, Mandarin Chinese-, and Malay-dominant speakers show traces of these variants despite them

existing in their L1's phonemic system. Both variants were produced during the minimal pairs task and can be considered as projections of similar consonants from the other pair word.

Starting with the variant /b/, it was seen in the word 'mop' being pronounced as /mɒb/ instead of /mɒp/, with the succeeding pair word being 'mob', pronounced as /mɒb/. A total of one English-dominant speaker whose second language is Malay, four Mandarin Chinese-dominant speakers, and three Malay-dominant speakers exhibited this variant despite the target consonant /p/ being an existing phoneme in Mandarin Chinese and Malay (Phoon et. al., 2013). Besides that, the /p/ sound is a common consonant in coda positions such as in the word 'mop' while in Mandarin Chinese Pinyin, both the consonants /b/ and /p/ translate to the /p/ sound in IPA transcription (Odinye, 2022), further solidifying that this variant was not caused by any L1 influence. It can be concluded that the variant /b/ occurs in place of /p/ due to the speakers' fossilized interlanguage as they are unable to clearly show contrast between the two plosive consonants of voiced /b/ phoneme and voiceless /p/ phoneme.

Similarly, the voiced velar plosive /g/ variant is employed instead of the voiceless velar plosive /k/ in the word 'dock', changing the accurate pronunciation of /dɒk/ to /dɒg/. The word 'dock' is also placed as the precedent of the pair word 'dog' pronounced as /dɒg/ which leads to the same conclusion that the variant is attributed to speakers' fossilized interlanguage and influence from the other pair word rather than influence from their L1. This variant phoneme was produced by the same English-dominant speaker and two Mandarin Chinese speakers. As the English-dominant speaker's second language is Malay, it can be observed that the /k/ phoneme exists in the Malay consonant inventory albeit not being typically used in an onset position (Phoon et. al., 2013) while in Mandarin Chinese Pinyin, both velar plosives /k/ and /g/ are pronounced with the /k/ sound (Odinye, 2022). The same conclusion can be drawn that this variant occurs because of

the prevalence of a fossilized interlanguage, leading to the inability to clearly differentiate the two minimal pair words of ‘dock’ and ‘dog’.

5.2.3.5 Variant /ʃ/

The last consonant variant for reinterpretation of differences is the use of the voiceless postalveolar fricative /ʃ/ in place of the voiceless alveolar fricative /s/ observed in one of the Mandarin Chinese-dominant speakers. This occurrence was seen in the word ‘sushi’ being pronounced as /ʃuːʃi/ instead of /suːʃi/ by one Mandarin Chinese-dominant speaker during free conversation. Similarly in English, both phonemes are used as syllable-initial consonants with the onset position (Phoon et. al., 2013). This leads to the conclusion that the L1 influence does not play a role in producing this variant but points to the speaker’s underdeveloped interlanguage causing them to replace the /s/ phoneme with /ʃ/ as it is also the onset of the next syllable.

5.1.3.7 Variant /ɑː/

The next focus will be on the variant vowels produced under reinterpretation of differences, starting with the variant /ɑː/, a low central tense vowel. The first situation that the variant /ɑː/ was identified was in the word ‘money’ pronounced as /mɑːni/ instead of the accurate /mʌni/ by the English-dominant speaker in the free conversation task. As the speaker’s second language is Mandarin Chinese, this occurrence can be explained by the non-existent distinction between long and short, or tense and lax vowels (Odinye, 2022), causing the selection of the mid central lax vowel /ʌ/. However, as the speaker did not produce the /ɒ/ sound shows that the interlanguage is not entirely fossilized as the letter ‘o’ in Mandarin Chinese Pinyin is pronounced as /ɒ/. It can be assumed that this variant occurred due to the lack of correction of the variant, leading to an underdeveloped interlanguage.

5.2.3.8 Variant /ɑː/ and /ɛ/

Moving on, the target phoneme /æ/, a low front lax vowel, was observed to be replaced by the variants /ɑː/ and /ɛ/ on two different accounts. Firstly, the low central tense vowel /ɑː/ is used by one Tamil-dominant speaker in the word ‘mass’, pronouncing /mæs/ as /mɑːs/. As the vowel /æ/ is an existing vowel in Tamil (Kanapathy, 2015), the explanation for this variant’s occurrence can be due to influence from the transparent nature of Tamil orthography (Winskel, 2020) in which the letter ‘a’ maybe directly translate to the /ɑː/ or /ʌ/, causing the speaker to rely on this system and produce the variant /ɑː/ based on their perceived vowel length. Thus, it can be assumed that this variant was produced due to L1 influence as well as a lack of correction as ‘mass’ is a commonly used word, pointing towards a fossilized interlanguage.

The second variant that was observed to have replaced the target phoneme /æ/ was the mid front lax vowel, /ɛ/. A total of 3 English-dominant speakers, all six Mandarin Chinese-dominant speakers, all four Malay-dominant speakers and all four Tamil-dominant speakers exhibited this variant when pronouncing the word ‘pat’ in the minimal pairs task. According to Hua et. al. (2011) on Malay vowels and Odinye (2022) on Mandarin Chinese vowels, the vowel /æ/ does not exist in these languages albeit it being a feature in Tamil phonology as mentioned. On the other hand, the vowel /ɛ/ is a familiar and easier alternative for Mandarin Chinese- (Odinye, 2022) and Malay-dominant speakers (Winskel, 2020) as it is a commonly used phoneme in both languages. Moreover, this variant can also be caused by the speakers’ fossilized interlanguage being unable to provide a clear distinction for the phonemes /æ/ and /ɛ/ as the word ‘pat’ is followed immediately by the word ‘pet’ pronounced as /pɛt/, which can explain this phenomenon in not one but all four Tamil-dominant speakers despite the target phoneme /æ/ existing in Tamil phonology (Kanapathy, 2015). Simply put, the reason for these variant leans more towards the speakers’ interlanguage’s

inability to provide a clear distinction when met with another similar sounding word rather than completely due to L1 influence.

5.2.3.9 Variant /aʊ/

The last variant identified under reinterpretation of differences is the low central lax vowel to high back lax vowel /aʊ/ in the place of the target mid central lax vowel /ɔː/. This was seen in the pronunciation of the word 'Laura' as /laʊrə/ instead of /lɔːrə/ by one Mandarin Chinese-dominant speaker and one Malay-dominant speaker during the dialogue reading task. As both Malay and Mandarin Chinese are highly transparent orthographic languages (Winskel, 2020), the speakers may have directly translated the letters 'au' into the diphthong /aʊ/. However, the diphthong /aʊ/ does not exist in Malay phonology whereas /ɔː/ does which may seem contradictory, but this can be explained by the lack of development in the speaker's interlanguage in which they are unable to associate the 'au' spelling with any other sound other than what is alphabetically written and directly translates it into the diphthong /aʊ/ as in their L1 phonemic system.

5.2.4 Substitution of sounds

Substitution of sounds or phone substitution is applied to phonemes that exist in the speaker's L1 and target language but differs in normal pronunciation (Brière, 2021). According to Weinreich (1979), the substitution of sounds signifies the presence of foreign influence but is viewed as non-disruptive to communication. However, consistent occurrence of this interference without correction can cause the speaker's phonemic system of the target language to be affected (Weinreich, 1979). In this study, it can be observed that English-dominant speakers exhibit this interference the most compared to the other three types, with Mandarin Chinese-dominant speakers,

Malay-dominant speakers and Tamil-dominant speakers displaying one to four accounts of variants classified as substitution of sounds.

5.2.4.1 Variant /tʃ/, /b/ and /d/

In this study, it has been observed that the target phoneme /t/, a voiced alveolar plosive has been substituted with the variant phonemes /tʃ/, /b/ and /d/ respectively. Firstly, the variant voiced postalveolar affricate /tʃ/ has been displayed by four Mandarin Chinese-dominant speakers in the words 'strive', 'trouble', and 'terribly' in the free conversation task and the dialogue reading task. As Mandarin Chinese follows a CVC syllable structure that disallows consonant clusters, it is reasonable to assume that the substitution of /str/ and /tr/ for /tʃ/ in the words 'strive' and 'trouble' is to reduce the complex consonant clusters (Phoon et. al., 2013). Despite the phoneme /tʃ/ not being prominently used as a syllable-initial consonant, it serves to be the more familiar and supposedly appropriate replacement for the consonant cluster /tr/ rather than simply just /t/ which on the other hand, exists as a syllable-initial consonant in Mandarin Chinese (Phoon et. al., 2013). Furthermore, Phoon and Maclagan (2014) have observed that the post-alveolar approximant /r/ can affect preceding consonants as /tr/ and /str/ clusters will be pronounced with lip rounding. In the process of attempting to pronounce the plosive /t/ sound before /r/, it can be easy for slips to occur from plosive to affricate as affricates are similar to plosives in the sense that an affricate is produced by articulating a plosive while pulling the tongue away from the stop slowly to cause turbulent airstream (Kaur & Devi, 2020). As a result, it is not uncommon for Mandarin Chinese-dominant speakers to use the affricate /tʃ/ as substitution as a slight misplacement of the tongue closer to the alveolar ridge rather than the teeth will change the sound from a plosive to an affricate which explains the occurrence of the variant /tʃ/ instead of /t/ in the word 'terribly' despite not

being a consonant cluster. It also shows that the speakers' interlanguage is affected by L1 influence as affricate consonants are widely used in Mandarin Chinese (Phoon et. al. 2013).

Another variant used to substitute the phoneme /t/ is the voiced bilabial plosive /b/ that was produced by one Malay-dominant speaker in the word 'debt' during the free conversation task. The accurate pronunciation /dɛt/ was observed as /dɛb/ which can be explained as a reduction of consonant clusters as seen in spelling of the word 'debt' where the speaker may have found the written 'bt' cluster to be difficult and ended up choosing to articulate the /b/ sound instead of /t/. As Malay also follows a strict CVC syllabic structure, it can explain why the speaker decided to break up the perceived consonant cluster of 'debt' despite being influenced by the L1's transparent orthographic characteristics (Winskel, 2020). Thus, it can be said that the speaker's production of this variant is linked to the underdevelopment of their interlanguage as well as influence from their L1.

Lastly, the target phoneme /t/ has also been seen to be substituted by the voiced alveolar plosive /d/ by one Malay-dominant speaker in the word 'pretty' during the dialogue reading task. As the /t/ phonemes in the word 'pretty' are not articulated clearly as plosives but instead they are produced very lightly and in an unstressed manner. This can be observed as the flapping of intervocalic /t/ (Winskel, 2020) in which the /t/ phoneme is situated between two vowels in this case being the phoneme /ɪ/ and /i/. Flapping can be described as when one articulator strikes another in passing as an incidental effort and not a brief closure (Winskel, 2020). According to Evans and Watson (2002) have deduced that the flapping rule is used when the following vowel is unstressed, such as in this case where the final vowel /i/ in the word 'pretty' is unstressed. However, there are no flapping rules in Malay or any intervocalic alternations (Phoon et. al., 2013) which may have caused the speaker to substitute the flapped /t/ sound with a similar phoneme that exists

in the Malay phonemic system which is /d/. This shows the blend of Malay and English phonemic rules as the speaker is aware of the different pronunciation of /t/ in the intervocalic position but lacks the understanding of the concept of flapping, leading to an inaccurate depiction of it which is the phoneme /d/.

5.2.4.2 Variant /t/

Next, the variant /t/ has been observed in place of the target phoneme /d/ which is a voiced alveolar plosive in one Malay-dominant speaker and one Tamil-dominant speaker in the word list task. This variant occurred in the word 'road' being pronounced as /rəʊt/ instead of /rəʊd/. Theoretically, this occurrence of this variant is contradictory as the phoneme /d/ is a prominent consonant in Malay and Tamil and both languages follow a transparent orthographic system (Phoon et. al., 2013). However, it can be observed that voicing contrasts in coda positions are not crucial in Malay (Phoon et. al., 2013) and the plosives /t/ and /d/ are used interchangeably in Tamil (Kanapathy, 2015). To conclude, it can be assumed that the devoicing of stops from /d/ to /t/ shows that the speaker's interlanguage system is influenced by their L1's system on voicing contrasts as well as articulatory rules of syllable-final consonants.

5.2.4.3 Variant /v/ and /w/

The next variants /v/ and /w/ were observed to be used interchangeably among the participants and were seen in the words 'when' and 'van' produced by three English-dominant speakers and one Mandarin Chinese-dominant speaker during the minimal pair task. Similarly to other variants found in the minimal pair task, both these variants can be assumed to be interchanged in the words 'when' and 'van' due to influence from the pair word itself rather than L1 influence entirely.

Starting with the substitution of the target voiced labio-velar approximant phoneme /w/ for the variant voiced labiodental fricative /v/ in the word ‘when’ by two English-dominant speakers whose second languages are Tamil and Malay respectively. Besides being affected by the succeeding pair word ‘van’ which is pronounced with the /v/ sound, this variant can also be attributed to influence from the L1 albeit not entirely. In Tamil, the phonemes /v/ and /w/ are realized as one sound which is the voiced labiodental approximant /ʋ/ written as /வ/ in Tamil script (Kanapathy, 2015). As the /v/ sound in English may be more similar to the /ʋ/ sound in Tamil due to the place of articulation being labiodental that involves the lower lip and upper teeth compared to the labio-velar position of /w/ that requires lip-rounding and touching of the soft palate (Kaur & Devi, 2020), it leads to the English-dominant speaker’s interlanguage to be affected by the phonemic system of Tamil as well as influence from the succeeding pair word to substitute the phoneme /w/ with /v/. For the English-dominant speaker whose second language is Malay, it can be assumed that the variant occurred solely due to influence from the pair word ‘van’ as both phonemes /v/ and /w/ are important consonants that show clear distinction in Malay phonology (Phoon et. al., 2014). Again, this finding points to a fossilized interlanguage due to the inability to provide a clear distinction as an English-dominant speaker as none of the Malay-dominant speakers have been observed to exhibit this variant.

Conversely, the voiced labio-velar approximant /w/ has been identified as a substitution for the voiced labiodental fricative /v/ for the pair word ‘van’ in one English-dominant speaker and one Mandarin Chinese-dominant speaker. For the Mandarin Chinese-dominant speaker, this phenomenon can be explained due to the absence of the phoneme /v/ in Mandarin Chinese phonology. Instead, the /w/ sound is prominent as a syllable-initial consonant (Phoon et. al., 2013) which can be the reason for its usage in the place of /v/ in the word ‘van’ other than influence from

the preceding pair word ‘when’. On the other hand, this occurrence in the English-dominant speaker is not expected as their second language is Malay as well, similarly to the other speaker who substituted /w/ for /w/. However, it can be attributed to influence from the speaker’s third language which is Mandarin Chinese but not entirely feasible as their LEAP-Q results show a tendency to converse and read in English and Malay more. Thus, it is reasonable to draw the same conclusion that both speakers exhibit an underdeveloped interlanguage, with the speaker whose second language is Mandarin Chinese being affected by the L1’s absence of /v/ phoneme and the English-dominant speaker undergoing fossilization and being unable to differentiate between the /v/ and /w/ phoneme when they are placed in succession.

5.2.4.4 Variant /f/

Moving on, the voiceless labiodental fricative variant /f/ was the highest-occurring variant under substitution of sounds used to replace the voiced labio-velar approximant /v/. It was identified in two English-dominant speakers, all six Mandarin Chinese-dominant speakers, all four Malay-dominant speakers and all four Tamil-dominant speakers in the words ‘twelve’ and ‘halve’ being pronounced as /twɛlf/ and /hɑːf/ in the dialogue reading task and word list task.

For Mandarin Chinese speakers, this variant can be explained by the absence of the /v/ phoneme in Mandarin Chinese phonology as mentioned previously, causing the speakers to choose the closest phoneme which is /f/ (Phoon et. al., 2013). In Tamil phonology, it has also been observed that there is no true /v/ sound in which the closest phoneme is a mix of the phoneme /v/ and /w/. However, the speakers chose the phoneme /f/ to substitute the unfamiliar /v/ sound instead of the /w/ sound as applying the /w/ sound in place of /v/ in the word ‘twelve’ or ‘halve’ would prove to be very obviously inaccurate, leading the speakers to choose the more appropriate phoneme /f/ to replace the /v/ sound in this context. This can also apply to Malay-dominant

speakers in which both /v/ and /w/ sounds exist. Nonetheless, the Malay-dominant speakers have also chosen to substitute the /v/ sound with /f/ at the coda position as Malay phonology does not differentiate between voiced and voiceless consonants, causing the speakers to assume that the /f/ phoneme as the syllable final consonant to be accurate. Furthermore, the /v/ phoneme only exists in Malay marginal consonants which are only seen in loan words, showing that this phoneme is also unfamiliar in the context of the speakers' L1. Moreover, the word 'halve' may have been perceived as having the same pronunciation as the word 'half'. It is also important to note that complex consonant clusters are not practiced in these languages which can be a reason why the speakers attempt to simplify the cluster 'tw' and 'lf' by using a familiar and easier phoneme which is /f/. Therefore, it can be concluded that the speakers' interlanguage is heavily influenced by the phonemic systems in their L1 and have been produced consistently without correction as the targeted words are often used in daily life.

5.2.4.5 Variant /l/

For the last consonant variant under substitution of sounds, it was observed that the target voiced post-alveolar approximant phoneme /r/ was replaced by the voiced alveolar lateral approximant /l/ by one Mandarin Chinese speaker in the word 'ribs' during the dialogue reading task. In Mandarin Chinese, the Pinyin of /r/ sound is translated into a retroflex approximant /ɻ/ in which the tongue tip is curled backward into the mouth at the postalveolar region (Odinye, 2020). As the retroflex approximant creates a more muffled and darker sound compared to the postalveolar approximant /r/, it is easy for Mandarin Chinese speakers to assume the /l/ phoneme in place of /r/ as it is more familiar and easier to pronounce despite Mandarin Chinese being an orthographically transparent language (Odinye, 2020). As it can be observed, the speaker's

interlanguage maps the familiar /l/ phoneme onto the unfamiliar /r/ phoneme due to an absence of clear distinction between these two sounds in the L1.

5.2.5 Variants outside of the four categories

5.2.5.1Variant /əʊ/

Hypercorrection can be understood as the act of speakers extending a linguistic form beyond its regular usage that sometimes results in an inaccurate production (Eckman et. al., 2013). In an attempt to match the pronunciation of a word as accurately as possible in the target language, the speaker overshoots the mark and displays the incorrect form of the word (Eckman et. al., 2013). Weinreich (1979) also defines hypercorrectness as a speakers' excessive caution when articulating words in the target language that can cause errors or phonemic distinctions despite its absence in the speakers' L1.

This can be seen in the word 'knowledge' being pronounced as /nəʊlɪʤ/ instead of /nɒlɪʤ/ by a Mandarin Chinese-dominant speaker in the free conversation task. This is considered hypercorrection instead of a phonological interference because the diphthong /əʊ/ does not exist in Mandarin Chinese while the accurate phoneme /ɒ/ does (Odinye, 2020). This occurrence can be explained by the influence of the word 'know' which is indeed pronounced with the variant diphthong as /nəʊ/, leading the speaker to perceive that this is the correct pronunciation when articulating the word 'knowledge' despite the diphthong /əʊ/ being unfamiliar and more complex to articulate in the L1 context. Therefore, this points towards a fossilized interlanguage as the speaker is aware of the phonemic rules in the target language but is unable to identify the correct

context to apply it, and it can be assumed that this variant is a hypercorrection and not phonological interference.

5.2.5.2 Variant word ‘scream’ and ‘breath’

Lexical access starts when the conceptual features of the word are activated, leading to lemma retrieval, morphological encoding and phonological encoding through activation of the selected lemma nodes, morpheme nodes and segment nodes (Roelofs, 2000). When the speaker interprets the word correctly, the phonemes of the word will be selected, and the word will be produced correctly or incorrectly depending on the phonemes that are being activated. However, when an inaccurately pronounced word is produced as a real word and not a nonword, it refers to the lexical bias effect and not phonological interference (Costa et. al., 2006).

This effect is seen in the variant of ‘scream’ when pronouncing the word ‘squirm’ in the word list task. Four Mandarin Chinese-dominant speakers and one Malay-dominant speaker read the word ‘squirm’ as ‘scream’ which is not classified as any type of phonological interference but instead the lexical bias effect. This can be due to the word ‘squirm’ not existing in the speakers’ mental lexicon which caused them to choose the phonetically closest sounding word which is ‘scream’. Secondly, another variant caused by the lexical biased effect is the pronunciation of the word ‘breathe’ as ‘breath’ observed in one Mandarin Chinese-dominant speaker and three Malay-dominant speakers during the word list task. It can be assumed that the speakers know that the word ‘breathe’ is pronounced as one syllable despite seemingly split as two syllables orthographically into ‘bre’ and ‘the’. However, this might cause them to map the pronunciation of the word ‘breath’ instead as the /ɛ/ sound more accurately portrays that spelling of ‘ea’ compared to the actual pronunciation of /briːð/. Thus, as ‘breath’ is an actual word, the substitution of the word ‘breathe’ for ‘breath’ can be attributed to the lexical bias effect.

5.2.5.3 Variant /ɑː/

The variant identified is the low central lax vowel /ɑː/ in place of the high back tense vowel /uː/. This variant occurred in the word 'Ruth' during the dialogue reading task in one Mandarin Chinese-dominant speaker and one Malay-dominant speaker. However, the use of /ɑː/ in place of /uː/ does not tally with the phonemic characteristics of the two L1s as both Mandarin Chinese (Odinye, 2020) and Malay (Hua et. al., 2011) do not show vowel length contrast but possess the vowel of /ʊ/ which should be the logical replacement for /uː/. Furthermore, the articulatory positions of /ɑː/ and /uː/ are very different with /ɑː/ being pronounced with the mouth open wide and /uː/ being pronounced with rounded lips. Therefore, this variant occurs due to the speakers' own fossilized interlanguage and not influence from any L1, resulting in it being classified as a language error rather than phonological interference.

5.2.6 Conclusion for Research Question 1

As each language group contains different number of participants, the comparison will be made according to the mean number of variants produced by the specific language group in the categories of phonological interference.

For the category of underdifferentiation, both the English-dominant and Tamil-dominant participants produced a mean of 1 variant while the Mandarin Chinese-dominant group displayed a mean of 2 variants with the Malay-dominant group showing the highest mean number of variants which is 2.3. In terms of least-occurring category of interference, which is overdifferentiation, the English-dominant group did not portray any variants while both the Mandarin Chinese-dominant and Malay-dominant group produced a mean of 1 variant, leaving the Tamil-dominant participants

with the highest mean number of variants which is 1.3. Conversely, the highest-occurring category of interference, reinterpretation of differences saw the English-dominant group with the lowest mean of 2.8 variants while the Mandarin Chinese-dominant participants produced the highest mean of 4.7 variants. On the other hand, the Malay-dominant and Tamil-dominant groups show the mean numbers of 3.5 and 3.3 respectively. Lastly, the category of substitution of sounds identified that the English-dominant speakers produce the lowest mean number of variants once again which is 1 variant, with the Tamil-dominant participants following closely behind with a mean number of 1.3. The highest mean number of variants were also close, with the Mandarin Chinese-dominant group performing slightly better at a mean number of 2.3 variants while the Malay-dominant group produced a mean of 2.8 variants. Nonetheless, there were also 6 accounts of Mandarin Chinese-dominant speakers producing variants outside of the four categories as well as 2 variants produced by Malay-dominant speakers.

Thus, it can be concluded that in terms of the number of variants produced across all four categories of phonological interference, the Mandarin Chinese-dominant speakers showed the highest mean value of 9, indicating that on average one participant produced 9 variants while the English-dominant group produced a mean of 3.4 variant only, with the Malay-dominant group and the Tamil-dominant group producing a mean value of 7.8 and 5.8 respectively.

5.3 Discussion of types of suprasegmental interference present in different multilingual groups in Malaysia

5.3.1 Inaccurate stress pattern in polysyllabic words

This section will examine the variants produced in polysyllabic words according to the syllable stress position in the words in terms of syllable-initial stress, second syllable stress, antepenultimate stress and penultimate stress.

5.3.1.1 Syllable-initial stress

5.3.1.1.1 Comfortable

The first word to be discussed is ‘comfortable’ in which the primary stress is on the first syllable ‘com’ with the weakest stress being on the following syllable of ‘for’. The first variant for this word was observed in two Malay-dominant speakers in which it was the second syllable where the primary stress was identified. However, there is no evidence that this variant occurred due to influence from their L1 as research on Malay prosodic features have found penultimate stress to be more common (Don et. al., 2008). Furthermore, syllables that contain the CVC syllabic structure are presumed to have more emphasis as well (Don et. al., 2008). As neither of these features are seen in the produced variant, this study assumes that the occurrence is attributed to a fossilized interference and lack of correction regarding the incorrectly placed stress. It would also help to note that these two participants often interact with each other on a daily basis, thus solidifying the assumption of lack of correction and awareness regarding the produced variant.

Next, the second variant produced was that none of the syllables in the word ‘comfortable’ contained the primary stress. This was observed in two English-dominant speakers whose second language is Malay, two Mandarin Chinese-dominant speakers and one Malay-dominant speaker. Regarding the two English-dominant speakers and the Malay dominant speaker, this variant is also not attributed to the L1 influence as it does not fulfil the penultimate stress and CVC syllable stress features. For Mandarin Chinese-dominant speakers, the L1 is a tonal language in which syllables

are differentiated in terms of pitch level (Odinye, 2020) with equal timing and no dependency on stress (Hsieh, 2021). As there are no distinctive pitches assigned to a specific syllable in English, the speakers may revert to their L1 and transfer the equal syllable-timing feature to the word in English, producing a word in which all the syllables have equal stress. In other words, this can also be related to the speakers' lack of interlanguage development as they are unable to identify which syllable requires to be stressed and opted for the 'safe' option to leave all of them with equal stress.

5.3.1.1.2 Interesting

The next polysyllabic word is 'interesting' in which the primary stress falls on the first syllable 'in' while the second syllable of 'tres' holds the weakest stress with the schwa in the 'te' syllable is being reduced. The first variant observed is a lack of primary stress in either of the three syllables. Once again, this was observed in mostly Mandarin Chinese-dominant speakers with three of them producing this variant and one Malay-dominant speaker. When looking at the influence from Mandarin Chinese, it can be assumed that the Mandarin Chinese-dominant speakers are unsure of where to place the primary stress and decided to equally stress all three syllables, mapping the equal syllable-timing feature of the L1 onto this English word (Hsieh, 2021). It was also observed that the reduced syllable of 'te' was emphasized as well, pronouncing the word 'interesting' as four equally stressed syllables according to its orthographic spelling. In regard to the Malay-dominant speaker, it can be attributed to them not knowing which syllable to place the primary stress which led to equal stress between all four syllables as well. This can also be attributed to the fact that both Mandarin Chinese and Malay are highly transparent languages in terms of orthography (Winskel, 2020). When referring to the interlanguage, it can also be said that the speakers have encountered fossilization as the word 'interesting' is not an unfamiliar or difficult

word, but the lack of correction and influence from L1 may have caused to them to pronounce this word incorrectly.

As this study looks at the second variant produced by two Tamil-dominant speakers and one English-dominant speaker, it can be observed that the stress falls on the second syllable ‘tres’ which is supposed to contain the weakest stress. In Tamil phonology, the tendency of speakers is to place the stress on the first syllable in trisyllabic words or the syllable that contains a long vowel, follows the VC or even VCC syllabic structure (Pingali, 2009). As both the first and second syllable fulfils the feature of syllable structure for stress in Tamil, the stress should fall on the syllable ‘in’ as this word only contains three syllables. As a result, it can be concluded that this variant was exhibited due to a fossilized interlanguage rather than influence from the L1. Conversely, the English-dominant speaker also displayed influence from the L2 which was Malay as it fulfils the feature of penultimate stress and the CVC syllable structure of ‘tres’ compared to the VC structure of ‘in’ which is commonly seen in Malay stress patterns (Don et. al., 2008). Therefore, the occurrence of this variant can be attributed to influence of Malay as the second language of the speaker, but it also points to a lack of correction when pronouncing this word inaccurately as the speaker is first and foremost an English-dominant speaker.

5.3.1.1.3 Complicated

For the last polysyllabic word where the primary stress falls on the first syllable, it can be observed that the word ‘complicated’ was produced incorrectly by one Mandarin Chinese-dominant speaker in the first variant by omitting the primary stress from any of the four syllables. Similarly to the previous variants, the absence of primary stress can be attributed to the retaining of the L1’s feature of equalizing each syllable’s timing despite there being no tonal distinction of syllables in English (Hsieh, 2021). It can also be assumed that the speaker is uncertain of where to

place the primary stress, thus choosing to leave all the syllables equally stressed. Once again, this refers to an underdeveloped interlanguage as a word with four syllables without a primary stress would undoubtedly sound abnormal.

Moving on, another variant observed is that the primary stress was placed on the second syllable of 'pli' and was produced by another Mandarin Chinese-dominant speaker. However, this occurrence does not relate to the L1 influence as Mandarin Chinese does not practice syllable stress at all. As English is also the speaker's second language, it is assumed that the variant occurred not because of influence from any language but simply due to a underdeveloped interlanguage in which the speaker incorrectly placed the primary stress on the second syllable instead of the first one. It can also be assumed that there was no corrective effort made regarding the inaccurate stress which led to the fossilization of the speaker's interlanguage.

5.3.1.2 Second syllable stress

5.3.1.2.1 Responsibility

As a polysyllabic word in which the primary stress falls on the second syllable, the word 'responsibility' has its primary stress placed on the syllable 'pon' out of the six syllables in the word. Only one variant has been observed and was produced by four Mandarin Chinese speakers in which all six syllables were stressed equally with no primary stress. This occurrence can be explained by influenced from the speakers' L1 in which it practices equal syllable-timing instead of stress-based timing (Hsieh, 2021). The speakers revert to the familiar L1 prosodic features possibly due to not knowing where to place the primary stress when faced with six syllables to choose from. Evidently, this brings it back to the conclusion of the underdevelopment of

interlanguage in which the speakers are unable to identify the correct position for primary stress despite the word 'responsibility' being a familiar word.

5.3.1.2.2 Vocabulary

The word 'vocabulary', the primary stress lies in the second syllable out of the five syllables. There was only one observed variant produced by one Tamil-dominant speaker in which the primary stress was placed on 'vo', the first syllable. Linking this occurrence to the L1 influence, Pingali (2009) stated that Tamil speakers tend to place stress on the first syllable provided that the second syllable is not heavy in the sense that it is not a long vowel or contains a VC or VCC structure. For both the syllables of 'vo' and 'ca', they are not considered heavy as they follow a CV syllable structure, so by default the primary stress falls on the first syllable 'vo' in Tamil phonology. Therefore, this explains the prevalence of this variant in the speaker as an influence from L1 and also a lack of corrective action taken on this inaccuracy.

5.3.1.2.3 Economy

Moving on, the word 'economy' has the primary stress placed on the second syllable 'co'. The first variant observed was identified in three English-dominant speakers and one Mandarin Chinese-dominant speaker in which the primary stress was placed on the first syllable. Starting with the English-dominant speakers, one of their second language is Tamil, the second's is Malay while the third one is a monolingual but both the second and third speakers are of Indian ethnicity. As this variant is a clear influence of the Tamil prosodic system, it can be assumed that the three of them resorted to the more familiar stress pattern system given their Indian ethnicity and one of their second language being Tamil despite it not being their dominant language. As the syllable 'e' and 'co' are not considered heavy syllables, the primary stress falls on the first syllable which is 'e'. Consequently, it can be assumed that although Tamil is not the L1 in this case, influence from

an Indian ethnic background and environment can also affect the prevalence of interference. It is also worth noting that this reveals a fossilized interlanguage as all three speakers are English-dominant speakers.

Secondly, the next variant of this word occurred in one Mandarin Chinese speaker in which none of the syllables contained the primary stress. Similarly to the previous occurrences, this variant can be attributed to the tonal, not stress-based feature of Mandarin Chinese (Hsieh, 2021) phonology in which the speaker mapped its influence onto words in English. It can also be assumed that the speaker may have been unable to identify which syllable to place the primary stress, thus choosing to place equal stress and timing on each of the five syllables. To conclude, it can be assumed that the interlanguage of this speaker is considerably underdeveloped as they have been exhibiting several accounts of variants in which there is no primary stress.

5.3.1.2.4 Facility

Additionally, ‘facility’ is another polysyllabic word where the primary stress falls on the second syllable ‘ci’. It can be observed that the first variant was seen in three Mandarin Chinese speakers where there was no primary stress in all four syllables. According to Hsieh (2021), Mandarin Chinese does not practice stress patterns to differentiate syllables in which its influence can be identified in this variant where the speakers place equal stress on each syllable. Furthermore, the syllables all contain the same structure of CV which may have caused the speakers to be unsure regarding primary stress placement. In brief, it can be said that this variant was caused by L1 influence as well as the inability of the speakers to identify the correct stress placement

The next variant observed in this word was when the primary stress was placed on the first syllable ‘fa’ by one Mandarin Chinese-dominant speaker, three Tamil-dominant speakers and one

English-dominant speaker. The analysis will start with addressing this occurrence in the Tamil-dominant speakers, all four syllables are considered light syllables as they follow the CV structure and not VC or VCC nor are there long vowels. Thus, this causes the primary stress to be placed on the first syllable by default according to Tamil prosodic features as observed in the production of this variant (Pingali, 2009). This also applies to English-dominant speaker who comes from an Indian ethnic background as there is no relation of this variant to the speaker's second language, Malay. This is because Malay phonology favours stress on the penult, not the first syllable (Don et. al. 2008). Lastly, this variant produced by the Mandarin Chinese-dominant speaker is not related to influence from the L1 as Mandarin Chinese does not consist of any stressed syllables. Instead, it can be assumed that the speaker attempted to guess the correct placement of primary speech as this speaker exhibited a few similar variants in which the stress placement was in the incorrect position but not absent. In essence, the production of this variant from all three groups of speakers can be attributed to a fossilized interlanguage in which the speakers either fell back on their L1 prosodic system or attempted to guess the stress placement in producing the polysyllabic word.

5.3.1.2.5 Invisible

Lastly, the primary stress falls on the second syllable, 'vi', in the word 'invisible'. However, two different variants have been observed in producing this word. Firstly, one English-, two Mandarin Chinese- and one Tamil-dominant speaker was seen to produce syllable-final stress on the syllable 'ble'. Despite the English-dominant speaker's second language being Malay, it is understood that this variant is not caused by any L1 influence as Malay phonology commonly places stress on the penult (Don et. al., 2008), Tamil phonology stresses on the first syllable (Pingali, 2009) as it is also a heavy syllable with a VC structure, and Mandarin Chinese does not practice any stress on syllables (Hsieh, 2021), which does not relate to the occurrence of this

variant where the stress is placed on the last syllable where the vowel is supposed to be a schwa. However, it may be relevant to the tonal nature of Mandarin Chinese where the fourth tone carries a falling tone (Odinye, 2020) which may sound like the speaker is emphasizing on the syllable as the speaker may intend to use it to signify the end of the word. In conclusion, it can be said that this variant stems from the speakers' underdeveloped interlanguage as they are unable to determine the correct stress placement, and it may also be caused by a lack of correction and awareness of the correct stress pattern in polysyllabic words.

Additionally, two Malay-dominant speakers and one Tamil dominant speaker exhibited another variant in which the primary stress fell on the first syllable. When addressing this occurrence in the Malay-dominant speakers, it is evident that this variant is not a feature of Malay phonology as it favours penultimate stress, not syllable-initial stress. A possible explanation is due to generalization of syllable-initial stress in polysyllabic words due to the inability to identify the correct stress placement in different positions. On the other hand, this is a clear influence of Tamil phonology as stress in trisyllabic or polysyllabic words usually fall on the first syllable, especially since the syllable 'in' follows a VC syllable structure that is a feature of heavy syllables (Pingali, 2009). All in all, this variant in the Tamil-dominant speaker may stem from L1 influence, but ultimately it is a result of a fossilized interlanguage that hinders all three speakers in identifying the correct stress placement in the polysyllabic word.

5.3.1.3 Ante-penultimate stress

5.3.1.3.1 International

The first polysyllabic word where the primary stress falls on the ante-penultimate, or the third to last syllable, is the word ‘international’, with the stress on ‘na’. There was one variant identified in this word produced by one Malay-dominant speaker where the primary stress was identified on the first syllable. As Malay phonology tends to stress the penult, the focus falls on the speaker’s third language, Tamil and also their Indian ethnic background. This is because this variant shows features from Tamil phonology where the stressed syllable follows the characteristics of a heavy syllable, containing the syllable structure of VC (Pingali, 2009). As this study assumes the root of the variant to be influence from the speaker’s ethnic background and third language, it is also important to note that it may more likely stem from a fossilized interlanguage and lack of awareness for the accurate stress placement as this speaker’s second language is English in which its features should be considerably more dominant than Malay.

5.3.1.3.2 Electricity

In the word ‘electricity’, the stress falls on the antepenult ‘tri’. However, it is observed to be the word with the highest-occurring variant, with five English-dominant speakers, five Mandarin Chinese-dominant speakers, three Malay-dominant speakers and four Tamil-dominant speakers placing the primary stress on the second syllable ‘lec’. In terms of influence from L1, it only applies to Malay and Tamil phonology as both languages prioritize stress on syllables with CVC (Don et. al., 2008) or VC (Pingali, 2009) syllable structure as seen in the syllable ‘lec’ while the other syllables are either V only, CV or CCV whereas Mandarin Chinese does not place stress on any syllable at all (Hsieh, 2021). However, a more accurate explanation for this occurrence is due to a lack of awareness for the actual stress placement and also that producing a CVC syllable after a vowel may be more natural and easier as the syllable of ‘lec’ is able to transition smoothly after a continuous sound of the first syllable ‘e’. Therefore, a conclusion can be drawn in which

this variant occurred not because of L1 influence but mainly due to a fossilized interlanguage as the speakers are unable to determine the correct position for primary stress and opted for the seemingly easier and more natural syllable to stress on. It can also be due to a lack of corrective measures which also stems from a lack of awareness regarding the correct stress placements.

5.3.1.4 Penultimate stress

5.3.1.4.1 Alternative

Finally, only one polysyllabic word contains penultimate stress which is the word 'alternative' in which the syllable 'na' is stressed. However, a total of two English-dominant speakers, 4 Mandarin Chinese-dominant speakers, three Malay-dominant speakers, and two Tamil-dominant speakers was observed to place the primary stress on the second syllable, 'ter'. When looking at Malay phonology, the supposed stress placement should be on the penult which is 'na' while Tamil phonology would place the primary stress on the first syllable as it is a heavy syllable with a VC syllable structure. Furthermore, Mandarin Chinese phonology does not implement any stress to provide distinction in syllables (Hsieh, 2021) which should result in all the syllables having equal stress. As this is not the case, it is evident that the cause of the variant is not from L1 influence but it may be due to the participants perceiving 'alter' and 'native' as two separate words in pronunciation, thus applying stress to both 'al' and 'na' with the primary stress on 'na'. Consequently, it is safe to assume that the L1 influence is not the cause of the variance, but rather the lack of development in the speakers' interlanguage which led them to perceive one polysyllabic word as two words as well as the lack of awareness for the correct pronunciation.

5.3.2 Inaccurate stress pattern in compound words

All the compound words used in the reading test have word-initial stress; thus, this section will look at the variants from each compound word individually. The analysis of stress pattern in compound words follows the same system as polysyllabic words, with Malay phonology favoring penultimate stress, Tamil placing stress on heavy syllables if not the first syllable, and Mandarin Chinese not practicing syllable stress whatsoever.

5.3.2.1 Variant stress on the second syllable or second word

The first type of variance identified in pronouncing compound words was primary stress on the second syllable. This was seen in the words ‘airport’, ‘handshake’, ‘firefighter’, ‘football’, toothbrush’, cupcake’, ‘butterfly’, ‘newspaper’, ‘jellyfish’ and ‘waterfall’.

In the word ‘airport’, this variant was produced by three English-dominant speakers, three Mandarin Chinese-dominant speakers and two Malay-dominant speakers; this variant in ‘handshake’ was seen in two English-dominant speakers, two Mandarin Chinese-dominant speakers and two Malay-dominant speakers; the word ‘football’ also produced this variant in three English-dominant speakers, two Mandarin-Chinese speakers, three Malay-dominant speakers and two Tamil-dominant speakers; in the word ‘toothbrush’, this variant was identified in three English-dominant speakers, five Mandarin Chinese speakers, two Malay-dominant speakers and three Tamil-dominant speakers; for the word ‘cupcake’, this variant was present in one English-dominant speaker, one Mandarin Chinese-dominant speaker, two Malay-dominant speakers and two Tamil-dominant speakers; and this variant in the word ‘newspaper’ was exhibited in one English-dominant speaker.

These six compound words are categorized together as the second syllable is also the second word. From the L1 perspective, this variant is not influenced by any of the dominant

languages as it does not fulfill the Malay feature of penultimate stress (Don et. al., 2008), the Tamil feature of stressing the heavy syllable (Pingali, 2009) as both the first and second syllables contain CVC syllable structure and even may be perceived as the heavier syllable, nor the practice of equal syllable timing and stress of Mandarin Chinese (Hsieh, 2021). Consequently, the prevalence of this variant in these six words can be attributed to the fact that the speakers view the second word as the more important one out of the two. The word 'port' in 'airport' refers to a place where vessels take on or discharge cargo (Merriam-Webster, n.d.) while 'air' merely indicates its location or specific purpose; the word 'shake' in 'handshake' shows the actual action being done while hand refers to the body part involved; the word 'ball' in 'football' signifies the object being used in the sport (Merriam-Webster, n.d.) while 'foot' specifies the exact type of sport; the word 'brush' in 'toothbrush' points to the bristled device itself used for scrubbing (Merriam-Webster, nd.) while 'tooth' gives a more detailed idea as to what the brush is used for; the word 'cake' in 'cupcake' directly indicates the dessert itself rather than the adjective of 'cup'; and lastly, the word 'paper' in 'newspaper' signifies the medium in which the information is printed on while 'news' specifies the information on the medium. While there is another third syllable in the word 'newspaper', it can be explained by the fact that the speaker understands that the second syllable in the word 'paper' is meant to be reduced as a schwa and left it unstressed. Therefore, speakers with a less developed interlanguage may assume that the second syllables are more important given their lexical meaning and choose to apply stress on them due to a lack of awareness for the correct stress placement.

Next, for the word 'butterfly', it is not categorized with the other six compound words as the second syllable is still considered a syllable in the first word 'butter'. This variant was produced by one English-dominant speaker, three Mandarin Chinese-speakers, three Malay-dominant

speakers and two Tamil-dominant speakers. Firstly, the influence of Malay phonology can be applied to the Malay-dominant speakers and the English-dominant speaker as their second language was Malay. This is because Malay phonology favors penultimate stress (Don et. al., 2008) which is the 'ter' syllable in which it can be observed that these speakers fall back on the familiar stress positioning of Malay. In terms of Mandarin Chinese, it does not use stress to provide distinctive stress (Hsieh, 2021). Thus, it can be assumed that the three Mandarin Chinese-dominant speakers simply attempted to guess where the correct stress placement was and settled for the syllable 'ter' as it has a clear CVC syllable structure compared to the other two syllables. Lastly, in terms of the Tamil-dominant speakers, Tamil phonology favors stress on VC or VCC syllables and on the first syllable (Pingali, 2009), which does not relate to the syllable 'ter'. As a result, it can also be assumed that Tamil-dominant speakers have attempted to guess the correct stress placement and settled on 'ter'. This can be because 'ter' follows an obvious CVC structure as the syllable 'but' may be assumed to be 'bu' at first glance with speakers associating the two 't's as one, and with the last syllable having a CCV syllable structure. Therefore, it can be said that the Malay-dominant speakers may have been affected by the familiar features of their L1 but all in all, the speakers produced the variant as a result of fossilized interlanguage as they opted for the easier syllable to place stress on due to a lack of understanding where the correct placement should be.

Lastly, for the word 'firefighter', 'jellyfish' and 'waterfall', it was found that one Malay-dominant speaker placed emphasis on the third syllable; while it was seen in two English-dominant speakers and three Mandarin-Chinese speakers in the word 'jellyfish'; and finally in one English-dominant speaker, two Mandarin Chinese-dominant speakers and one Malay-dominant speaker in the word 'waterfall'. As the third syllable is also the first syllable of the second word, this occurrence is similar to the variant seen in first category of the eight compound words despite the

stress being placed on the third syllable instead of the second because the speaker identifies the second word to be more important than the first word. With ‘fighter’ action being the action done by a person of that occupation, and ‘fire’ being the object that the person is dealing with; the word ‘fish’ also gives insight to the nature of the creature while ‘jelly’ describes it appearance or texture; and finally the word ‘fall’ gives precedence to the motion and action of the object while ‘water’ merely points out what object undergoes the particular motion. The speakers also understand the concept of reducing schwas in syllable final positions, resulting in only the third syllable being stressed. Furthermore, this can also be attributed to the Malay phonological feature of stressing the penult (Don et. al., 2008) but not in Tamil and Mandarin Chinese phonology. To conclude, this variant can be explained by the speaker’s lack of awareness regarding the stress placement and assuming the more important syllable based on meaning. It can also be understood as the speakers’ interlanguage being susceptible to interference and influence from the L1 due to fossilization.

5.3.2.2 Variant stress on last syllable

Additionally, participants were also found to place stress on the last syllable, which is not the first syllable of the second word. This was seen in the words ‘firefighter’, ‘newspaper’ and ‘pineapple’ where English phonology would require the last syllable to have a reduced schwa. Instead, the word ‘firefighter’ showed one Mandarin Chinese-dominant speaker stressing the syllable with the supposedly reduced schwa while the word ‘newspaper’ saw one English-dominant speaker, two Mandarin Chinese-dominant speakers and three Malay-dominant speakers with the variant in the word ‘pineapple’ being produced by three Mandarin Chinese-dominant speakers, one Malay-dominant speaker and one Tamil-dominant speaker. When looking at the phonology of Tamil, this variant does not apply to its features and it can be assumed that the Tamil-

dominant speakers did not know where to place the stress in these three compound words, which caused them to resort in stressing the last syllable as an emphasis on their perception of English phonology or even as an afterthought. This is also applicable to Malay-dominant speakers producing this variant in the words 'firefighter' and 'pineapple'. However, in Malay phonology, the stress can be delayed to the final syllable instead of the penult when the penult contains a central vowel (Don et. al., 2008). In the word 'newspaper' where three Malay-dominant speakers were identified to produce this variant, the penult contains the central vowel of /eɪ/ in the syllable 'pa'. Thus, this could be a factor as to why the final syllable was stressed. On the other hand, Mandarin Chinese speakers may have been influenced by its tonal nature as it has four different tones in which the fourth tone starts with a high pitch and ends with a falling tone (Jongman et. al., 2006), similar to how a speaker would articulate stress in English. As a result, the speakers may have attempted to show the finality of the final syllable by mapping the features of the fourth tone, thus placing stress on the last syllable. In brief, this variant may have stemmed more from a lack of awareness for the correct stress placement or from a fossilized interlanguage that caused the speakers to rely on their L1 system.

5.3.2.3 Variant stress on all syllables

Lastly, the final type of stress variation was identified in participants placing stress in all syllables. This variant was produced by one English-dominant speaker, three Mandarin Chinese-dominant speakers, one Malay-dominant speaker and one Tamil-dominant speaker in the word 'airport'. It was also seen in the word 'handshake' by one English-dominant speaker, two Mandarin Chinese-dominant speakers, and one Tamil-dominant speaker while also exhibited by two English-dominant speaker, two Mandarin Chinese-dominant speaker, and one Malay-dominant speaker in

the word ‘firefighter’. This variant was also identified in one English-dominant speaker and one Mandarin Chinese-dominant speaker in the word ‘grandmother’ and in two Mandarin Chinese-dominant speakers and one Tamil-dominant speaker in the word ‘cupcake’. The word ‘newspaper’ also saw a total of two English-dominant speakers, one Mandarin Chinese-dominant speaker, and one Tamil-dominant speaker producing this variant as well as one English-dominant speaker and two Mandarin Chinese-dominant speakers in the word ‘jellyfish’. Finally, one Mandarin Chinese-dominant speaker produced this variant in the word ‘pineapple’ as well as one English-dominant speaker and two Mandarin Chinese-dominant speakers in the word ‘waterfall’.

Evidently, this variant occurred mostly in Mandarin Chinese-dominant speakers. This can be attributed to the fact that Mandarin Chinese does not focus on stress to provide any lexical meaning or distinctions to a syllable as it is a tonal language (Hsieh, 2021). Therefore, Mandarin Chinese-dominant speakers may view each syllable as equally important, placing stress on every syllable to ensure equal timing and emphasis in attempt to show the perceived accuracy of the word. For Malay- and Tamil-dominant speakers, as this variant does not tally with the features of their L1’s phonology, it can be explained by an absence of awareness regarding stress placement and pronounce each syllable with stress to avoid having to choose one syllable to place primary stress on. Another explanation that also can apply to the English-dominant speakers is that it is an attempt to overcompensate for accuracy. The speakers may have the intention of not wanting to leave important syllables stressed and ensure that they can achieve native-like clarity which leads to the production of this variant in which every single syllable is stressed. As a result, it can be understood that even without the influence of L1 phonology, underdevelopment of the interlanguage in which the speakers are unaware of the stress placement rules of English

phonology can result in variants like this that can give the perception of a foreign accent in their attempt to achieve high levels of accuracy in pronunciation.

5.3.3 Inaccurate stress placement in sentence reading

At sentence-level, misplacement of stress can be common in the speaker and difficult to detect by the hearer as an error because practically any word can carry the primary stress in a sentence depending on the intended meaning (Cutler, 1980). Thus, the stress placement in sentences may often be misplaced which will result in the intended meaning of the speaker to be different from what the hearer interprets. However, the hearer will not know that an error has occurred in the sentence unless the speaker corrects themselves (Cutler, 1980). Consequently, the sentences in this study already contain the designated words that are meant to be stressed so it will be obvious when variants in stress placement occur that it is due to the speaker regarding another word to be more important rather than the designated word.

5.3.3.1 Sentence 1: ‘We need to finish the project overnight, not over the weekend.’

In the first sentence, the designated word with primary stress placement is ‘overnight’ to emphasize the correct deadline for the project. Firstly, it was observed that a Mandarin Chinese-dominant speaker placed variant primary stress on the word ‘not’. This can be explained as contrastive stress where the speaker attempted to show distinction between the correct deadline for the project and the incorrect one. However, this may imply that there was a previous sentence where another speaker assumed that the deadline was ‘over the weekend’. As a result, this variant occurred due to the inability of the speaker to align with the suprasegmental features of English.

All in all, it can be attributed to an underdeveloped interlanguage which caused the speakers to be unaware of the important of correct stress placement in delivering an utterance.

5.3.3.2 Sentence 2: 'You should buy food at the supermarket and not at the convenience store, because it will be much cheaper.'

The designated primarily stressed word in this sentence is the word 'supermarket' to show emphasis on the preferred place to buy food. In this sentence, the same variant was observed in which two English-dominant speakers and one Mandarin Chinese-dominant speaker. The speakers are also assumed to be practicing contrastive stress by showing emphasis that the convenience store is not the preferred location to buy food. However, this type of stress only applies when there is a previous sentence that indicated that the convenience store is the ideal location for purchasing food. Thus, as a sentence that stands alone, stressing the word 'not' may bring the hearer's attention to the 'convenience store' rather than the 'supermarket'. As the speakers who produced this same variant in Sentence 2 were different from the speaker in Sentence 1, it is a clear indication of an underdeveloped interlanguage in which the speakers identify different words to be of importance despite both sentences having the same structure and meaning with only the content that differs.

5.3.3.3 Sentence 3: 'Mary's flight arrives at six in the morning, not six in the evening.'

Next, the third sentence prioritizes the primary stress on the word 'morning' to show the two different indications of 'six o'clock'. However, it was observed that one English-dominant speaker placed primary stress on the word 'not'. Again, this speaker can be understood as utilizing contrastive stress, but it is incorrectly used as there is no prior utterance that suggested the intended time was six in the evening. It brings the focus to the second half of the sentence instead of the main point which is 'six in the morning'. Furthermore, this speaker also showed this variant in the second sentence but not the first one. Evidently, it also points to a fossilized interlanguage in which

the speaker is unable to correctly and consistently identify the placement of primary stress in a sentence that is compatible with English phonological rules.

5.3.3.4 Sentence 4: ‘The email was meant for John, but Sarah was the one who received it.’

The fourth sentence has a different structure than the previous three sentences in which the primary stress is on the word ‘Sarah’ to indicate the actual person who received the email instead of ‘John’ who refers to the person who was supposed to receive it. In this sentence, all participants were observed to place the stress accurately except for those who showed no stress placement whatsoever.

5.3.3.5 Sentence 5

The final part of the sentence reading task was positioned as a conversation where there were three separate parts of question and answer as seen in Appendix 7. Each of the designated primary stress is placed on the word that directly relates to the question being asked.

The first sentence focuses the primary stress on the word ‘bought’ to answer the question of ‘What did Mary do?’ by emphasizing on the direct course of action conducted by Mary. For the second question of ‘What did Mary buy?’, the correct primary stress placement would be on the word ‘book’ to directly indicate the object purchased by Mary. Lastly, the third sentence places primary stress on the word ‘caterpillars’ as an answer to the question of ‘What kind of book did Mary buy?’.

However, as the variants produced in all three sentences are of similar nature, this section will conduct the analysis according to the variants rather than the individual sentences.

5.3.3.5.1 Variant of stress placement on questions

Firstly, it was observed that three Mandarin Chinese-dominant speakers and two Tamil-dominant speakers placed emphasis on the question itself and not on the answer while one English-dominant speaker, four Mandarin Chinese-dominant speakers and two Tamil-dominant speakers produced this variant in the second question and lastly, it was also identified in the exact same participants as in the second question. This can be explained by the fact that the answer to all three questions remained the same while it was the questions that differed. Thus, the speakers may perceive the questions as the main focus and emphasize the questions in an attempt to display native-like accuracy. This variant also reflects the lack of awareness regarding the actual focus in the conversation as the crucial information lies in the answer and requires specific words to be stressed according to the question asked. Therefore, this may reduce the efficiency of communication between the hearer and speaker as it will be more difficult to discern which part of the conversation actually carries the important information. In essence, this shows the fossilization in the speakers' interlanguage as they show the inability to accurately place stress in utterances. It also implies that the speakers prioritize the sentences that seem different which shows that the communicative intent is not the core focus. If this variant is brought into daily life conversations, it may be detrimental to their quality of communication and lead to misunderstandings.

5.3.3.5.2 Variant stress on 'about'

In this variant in which speakers place primary stress on the word 'about' located in each of the answers, it was seen to be produced in one Malay-dominant speaker in the first sentences and in the same three speakers which were one English-dominant speaker, one Malay-dominant speaker and one Tamil-dominant speaker in both the second and third sentences. This variant can be explained by the fact that the speakers identify the important part of the answer as the type of

book that Mary is reading. As the description of the type of book can serve as an adjective, it can be easily changed to describe the book as something else which causes the speakers to emphasize on the fact that the content is about caterpillars. Furthermore, as it has been seen across the stated variants that the speakers often misplace stress due to a lack of understanding for English phonological rules or a self-perceived importance regarding certain words inconsistently throughout the three sentences, it can be assumed that the speakers place stress randomly or rhythmically. Consequently, it is also possible that because the word 'book' and 'caterpillars' are nouns with the function word 'about' being wedged in the middle, the speakers choose the lexically different word to emphasize on. As this variant was not produced by the English-dominant speaker and Tamil-dominant speaker in the first sentence but only in the last two sentences, it is also an indication of inconsistency in the speakers' interlanguage when selecting words to place primary stress. This can be due to a lack of understanding of English suprasegmental rules which results in them simply choosing any word just for the purpose of placing stress to show a somewhat native-like accuracy.

5.3.3.8 Variant of total absence of stress

In each of the seven sentences, the variant in which none of the words were placed with primary stress and all the words have equal stress and timing was present. In this first sentence, it was seen in two English-dominant speakers, one Mandarin Chinese-dominant speaker and one Malay-dominant speaker. The second sentence saw a total of one English-dominant speaker, three Mandarin Chinese-dominant speakers and one Malay-dominant speaker producing this variant while the third sentence identified this variant in two English-dominant speakers, three Mandarin Chinese-dominant speakers and one Malay-dominant speaker. In the fourth setnece, one English-dominant speaker, two Mandarin Chinese-dominant speakers and one Malay-dominant speaker

showed this variant while it was exhibited in one English-dominant speaker, three Mandarin Chinese-dominant speakers and one Malay-dominant speaker in the fifth sentence. Finally, the sixth sentence saw a total of two English-dominant speakers and three Mandarin Chinese-dominant speakers displaying this variant while this variant was identified in the seventh sentence in two English-dominant speakers, three Mandarin Chinese-dominant speakers and one Malay-dominant speaker.

This can be attributed to the speakers' regarding the test as a reading exercise similarly to what is practiced in Malaysian schools in which reading exercises focus on grammatical and pronunciation accuracy rather than delivery in terms of stress placement and intonation. It is believed that this total absence of stress placement stems from the education policies of English teaching in Malaysia as most of the participants were subjected to the Integrated Secondary Schools Curriculum or Kurikulum Bersepadu Sekolah Menengah (KBSM) syllabus (Darmi & Albion) or even further before English was viewed as an important language. This can be supported by studies on criticisms in teaching English communication in Malaysian classrooms as fundamental language skills such as phonetics and basic aural-literacy skills are not taught to students (Azman, 2016). Furthermore, the educational policy has been criticized to produce inadequately trained English teachers who are not proficient themselves, limited time allocated for language teaching, lack of learning resources, difference between curriculum and pedagogical realities as well as the ever-present fear of language endangerment (Azman, 2016). Moreover, Malaysian students were also reported to experience language anxiety in which they are afraid of producing wrong responses in the target language which is English (Darmi & Albion). This causes them to become linguistically isolated and unaware regarding the correct use of English due to fear of being negatively evaluated or shamed by their teachers in front of their peers (Darmi & Albion).

It was also observed that this language anxiety is carried by students up until university level and it can severely hinder the progress of developing their language skills and interlanguage (Darmi & Albion). According to Azman (2016), it is important for teachers to teach about the language as well as to teach about how to communicate in the language, but it is unfortunate that local research discovered that limited input is provided to students before engaging in English communicative activities. Thus, the absence of stress placement in sentences can be attributed to the lack of phonological instruction and an ideal educational environment where the language learners can actively practice their use of English and gain constructive criticism from their instructors. Instead, Malaysia's English educational system and policies during the KBSM period may have been a factor in the underdevelopment of the speakers' interlanguage, creating a lack of knowledge or lack of awareness regarding the importance of suprasegmental features in utterances which then leads to monotonous speech patterns even at university level.

5.3.4 Conclusion of Research Question 2

As each language group contains different number of participants, the comparison will be made according to the mean number of variants produced by the specific language group as observed in terms of the three suprasegmental stress tasks.

Firstly, the task of polysyllabic word reading showed that the English-dominant group had the lowest mean value of 2 variants while the Mandarin Chines-dominant speakers was observed with the mean value of 4.5 variants. The Tamil-dominant speakers and Malay-dominant speakers were also not far behind with a mean value of 2.8 and 3.3 respectively. Moving on, it was evident in the reading of compound words, that the Tamil-dominant group produced the mean lowest value of 3.8 variants while it was the Mandarin Chinese-dominant group that showed the mean highest

value of 7.3 variants. On the other hand, the English-dominant speakers displayed a mean of 4.1 variants with the Malay-dominant speakers exhibiting a mean of 5.3 variants. Lastly, the final task of sentence reading saw that it was the Mandarin Chinese-speakers who showed the highest mean value of 5.2 variants while the Tamil-dominant group once again displayed the lowest mean value of 2 with the Malay-dominant group and English-dominant group obtaining a mean value of 2.3 and 2.6 variants respectively.

As a result, it is evident that the Mandarin Chinese-dominant speakers produced the highest mean number of variants across the three suprasegmental tasks with a value of 17, implying that on average, one Mandarin Chinese-dominant speaker in this study exhibited 17 suprasegmental variants. Conversely, it was the Tamil-dominant group that showed the lowest mean number of suprasegmental variants with a value of 8.5 variants. This was followed closely by the English-dominant speakers with a total mean value of 8.7 and the Malay-dominant speakers with a mean value of 10.8.

5.4 Significance of Interlanguage on the prevalence of phonological interference

After compiling both the variants under segmental and suprasegmental interference, it was identified that the Mandarin Chinese-dominant speakers produced a mean number of 26 variants. This means that throughout the entire reading test, one Mandarin Chinese-speaker displayed 26 variants on average. For the lowest mean number of variants, it was the English-dominant speakers with a mean value of 12.1 variants. Additionally, the Tamil-dominant speakers also performed well with a mean total of 14.3 variants across all the tasks with the Malay-dominant speakers producing a mean value of 18.6 variants.

As this study attributes the prevalence of variance to L1 influence as well as underdevelopment or fossilization of interlanguage, this section will look at the responses from the Language Experience and Proficiency Questionnaire (LEAP-Q) of the language group that produce the highest mean number of variants in terms of duration of exposure to English in their country, family as well as school or working environment, age of acquisition and fluency in terms of speaking and reading the language as well as the most important contributor in learning English.

Firstly, as Mandarin Chinese-dominant speakers exhibited the highest mean total of variants, it can be observed that out of six speakers, five of them do not interact with their family in English at all. On the other hand, all participants were exposed to English in school or work settings since they were around three years old. In terms of acquiring spoken English, majority started learning to communicate in English at four years old with two participants starting at eight years old while the age of them reaching fluency in spoken language ranged from primary school age to the latest of twenty years old. When looking at acquiring the skill of reading in English, it was found that the participants started acquisition around four to eight years old and reported their age of achieving fluency in reading English as young as five years old and as old as twenty-one years old. In this, it can be observed that despite the participants starting to acquire the language at an early age, it took some participants much longer time to actually achieve self-perceived fluency. Another question was regarding the most important contributor in the participants' learning of English in which the responses mostly included 'interacting with friends', 'watching TV', and 'listening to music/radio' while one or two participants also included 'reading' and 'language/self-instruction' tapes'. When addressing the contributor of 'interacting with friends', the participants may be interacting with friends that also have not achieved proficiency in English which may cause all the parties involved to influence each other's interlanguage but for worse as

they might not be able to detect errors in their friends' speech and may adopt mispronunciations or discrepancies from their friends in their own speech out of habit. Furthermore, contributors like 'watching TV', and 'listening to music/radio' only allows a one-way flow of learning where the participants can listen and absorb the medium such as a movie or song in English. However, they are unable to practice what they have learn as they will not be able to have a two-way communication through these methods which may lead to the inability to communicate in English proficiently despite having sufficient input regarding the language use. Evidently, many of the Mandarin Chinese-dominant speakers reported an early age of acquisition and achievement of fluency similar to English-dominant speakers; thus, it can be assumed that interaction with their family members as well as the medium for learning language played an important role in the development of their interlanguage. This is because all five participants who reported to have no interaction with their family members in English are university students in which majority of their years were spent with their families where a lack of communication in English would leave their interlanguage stagnant and unable to progress further. In terms of the medium of learning the language, most of them utilized informal learning mediums which may contain language errors in itself but there is no way of implementing corrective methods as the participants themselves or any involved parties might be unable to detect the errors as well as the inability to practice their communicative abilities in a two-way flow where they can receive constructive criticism.

As a result, the information from the LEAP-Q responses can provide an insight regarding the interlanguage of the language group that shows the most number of variants and it is evident through the amount of interaction they have in English as well as the method they use to acquire English that their interlanguage was not able to be as developed as the other language groups but instead underwent stagnation and fossilization.

5.5 Discussion on the effect of improved executive functioning on the prevalence of phonological interference

Both the Simon Test and Stroop Test that are involved in this study served to collect data regarding the participants' executive functioning (EF), also known as cognitive control (CC) in which there are three core EFs, inhibition, working memory and shifting (Ciprani et. al., 2025).

This study utilizes the Multivariate Analysis of Variance (MANOVA) to analyse and interpret the significance of the Simon Test and Stroop Test scores of the participants. The reason for using MANOVA instead of ANOVA as seen in many similar studies is because there are more than two dependent variables involved in this study, which are economic status, age, and language group in terms of multilinguals and bilinguals or monolinguals. Furthermore, the chances of identifying truly important factors in the study is higher and can also reveal differences that may not be picked up by ANOVA tests (French et. al., 2008).

At the multivariate level, significance tests of Pillai's Trace, Wilks' Lamda, Hotelling's Trace and Roy's Largest Root were run to determine whether or not the independent variables of age, economic status and language group had a statistically significant effect on the combination of dependent variables, which are the compatible, incompatible and Simon Effect scores as a whole.

The standard threshold of statistical significance is when the p-value is equal or more than .05 for all four significance tests (Leo & Sardanelli, 2020). The Partial Eta Squared ($\eta 2$) values are also meant to determine 'effect size' which is used to understand how pre-existing categories in the research can relate to outcomes in the future, instead of only in the current experiment where the conditions are controlled (Richardson, 2011), basically evaluating whether there is a practical

effect for future research. According to Richardson (2011), a η2 of .0099 indicates a small effect size with weak practical effect; .0588 shows a medium effect size; and .1379 points towards a large effect size and strong practical effect.

5.5.1 Simon Effect

The results from the participants' attempt at the Simon Test that focuses on spatial stimulus-response was analysed using MANOVA via SPSS. The tests were run according to the significance of three factors, which are language group, in which group 1.0 stands for multilinguals and group 2.0 refers to bilinguals or monolinguals; economic status in which group 1.0 represents the T20 participants, group 2.0 for the M40 participants, and group 3.0 for the B40 participants; and age as the participants range from 22 years old to 51 years old. The analysed results are generated in terms of descriptive statistics (Appendix 20), multivariate tests (Appendix 21), and tests of between-subject effects (Appendix 22)

5.5.1.1 Mean Scores

In terms of compatible scores, it can be observed that the highest mean reaction time was from the multilingual group (M = 659.6, SD = 84.3) while bilinguals performed slightly better (M = 610.0, SD = 126.36). However, the high standard deviation score in the bilingual group may indicate that there is inconsistent performance as the scores are spread out from the mean value. When comparing the mean scores in terms of economic status regardless of language group, the B40 group appeared to have the highest mean reaction time (M = 665.78, SD = 105.88) while the T20 group exhibited a better performance with the lowest mean scores (M = 616, SD = 9.9) but this can be attributed to the fact that there are only 2 participants who are multilinguals under T20

group and 9 participants under B40, 8 being multilinguals and one bilingual, and the high standard deviation of the B40 group also indicates inconsistent performance throughout participants of this group. In a nutshell, the bilingual group and T20 group appear to perform better when faced with compatible stimuli.

On the other hand, the incompatible scores showed that the multilingual group displayed the lower mean reaction time out of the two groups (M = 627.53, SD = 114.87) with the bilingual group showing the higher mean reaction time of 651.17, SD = 162.7). The standard deviations also show that the performance of the multilingual participants are more consistent as the scores are clustered around the mean value while the bilinguals show a more diverse range of scores. In terms of economic status, it is yet again the T20 group that produced the lowest mean reaction time (M = 581.5, SD = 10.6) while it is the M40 group with 5 bilinguals and 5 multilinguals that showed the highest mean reaction time in incompatible conditions (M = 650.8, SD = 130.12). All in all, the multilingual group and the T20 group fared better in incompatible conditions compared to the other groups. However, when comparing the overall performance during compatible and incompatible stimuli, it was found that the overall better reaction time was in incompatible situations with a mean of 610.48 milliseconds while compatible situations saw a mean of 645.43 milliseconds as seen in Table 39.

Moving on, the Simon Effect is produced by subtracting the compatible scores from the incompatible scores and it can be seen that the group with the highest mean Simon Effect is the bilingual group (M = 55.67, SD = 81.83) while the multilinguals show a relatively low mean Simon Effect (M = -32.07, SD = 82.35) despite the participants' performance being slightly more inconsistent than that of the bilinguals. When looking at the economic status, it is the B40 group that showed the lowest mean Simon Effect (M = -38.11, SD = 90.97) while the M40 group

produced the highest mean Simon Effect out of the three groups (M = 26.5, SD = 90.27) with participants from both groups showing a wide range of Simon Effect scores. Therefore, the multilinguals and the B40 groups showed an overall better performance in the Simon Test. Table 43 and Table 44 show the scores of the different groups for clearer visualization.

Table 43

Mean compatible, incompatible and Simon Effect scores of multilinguals and bilinguals (language group)

Group	Mean Compatible Score	Mean Incompatible Score	Mean Simon Effect Score
Multilingual (1.0)	659.60	627.53	-32.07
Bilingual (2.0)	610.00	651.17	55.67

Table 44

Mean compatible, incompatible and Simon Effect scores of T20, M40 and B40 groups (economic status group)

Group	Mean Compatible Score	Mean Incompatible Score	Mean Simon Effect Score
T20 (1.0)	616.00	581.50	-34.50
M40 (2.0)	633.00	650.80	26.50
B40 (3.0)	665.78	627.67	-38.11

5.5.1.2 Significance of Age

In all four significance tests, the p-value was at .190 which is greater than the standard threshold of .05, indicating that the multivariate effect is not statistically significant. For the Partial Eta Squared value, the results showed $\eta^2 = .298$ which translates to a large effect size, suggesting that a considerable number of variances in the combined dependent variables of compatible, incompatible and Simon Effect test scores are associated with the independent variable of age. To summarize, a multivariate analysis of variance (MANOVA) was conducted to analyze the effect of the independent variable of age on the combined dependent variables of compatible, incompatible and Simon Effect test scores. The results have indicated that the multivariate effect of age was not statistically significant with Pillai's Trace = .298, Wilks' Lambda = .702, Hotelling's Trace = .424, and Roy's Largest Root = .424, all with $F (3, 13) = 1.836$, $p = .190$, $\eta^2 = .298$. Despite being not statistically significant, the effect size on age as an independent variable was large, indicating a meaningful proportion of variance explained by age.

Next, tests of between-subject effects were run to determine whether the independent variable of age significantly affects each of the dependent variables specifically. Regarding the compatible scores, the p-value was .166 which was higher than the cutoff point .005, implying that there is no statistically significant effect of age on compatible scores. The Partial Eta Squared value of .124 also shows a moderate effect size as it is between the values of .0588 and .1379, suggesting a moderately strong trend towards significance. For the incompatible scores, the p-value of .063 also shows that the effect of age is not statistically significant. However, it was close to the standard threshold of .05, displaying a marginally non-significant effect that may be worth investigating further. It also shows a large effect size with the Partial Eta Squared value of .212, which encourages more future research as it has strong practical effect. Lastly, the Simon Effect scores

proved to be statistically insignificant as well with a p-value of .397 while the Partial Eta Squared value was .048, indicating a small effect size as the value was between .0099 and .0588. It means that approximately 4.8% of the variance in the Simon Effect scores can be explained by age. To reiterate, a series of univariate ANOVA tests were conducted to analyze the effect of age on each dependent variable of compatible, incompatible and Simon Effect scores individually. The effect of age on compatible scores was observed to be insignificant, $F (1, 16) = 2.124$, $p = .166$, with a moderate effect size, $\eta^2 = .124$. The effect of age on incompatible scores approached significance despite being statistically insignificant, $F (1, 16) = 4.047$, $p = .063$, with a large effect size, $\eta^2 = .212$. The effect of age on the Simon Effect was found to be statistically insignificant as well, $F (1, 16) = .762$, $p = .397$, with a small effect size, $\eta^2 = .048$. Table 45 shows the effect of age on each dependent variable for better understanding.

Table 45

Effect of age as an independent variable on the dependent variables of compatible, incompatible and Simon Effect scores individually

	Compatible Score	Incompatible Score	Simon Effect Score
P-value	.166 (not significant)	.063 (marginally non-significant)	.397 (not significant)
Partial Eta Squared (η^2)	.124 (moderate effect size)	.212 (large effect size)	.048 (small effect size)

In essence, the independent variable of age does not affect the dependent variables of compatible scores, incompatible scores and Simon Effect scores of the participants. However, the

effect of age on incompatible scores, in which the word shown does not correspond with the location, was approaching significance and had a large effect size, implying a strong practical effect for future research with a larger sample size.

5.5.1.3 Significance of Economic Status

In terms of economic status, all four tests showed differing p-values that were all more than .05, showing that the multivariate effect is not statistically significant. However, the different Partial Eta Squared value for the four tests showed a large effect size of higher than .1379, indicating that there is a strong practical effect for further research with a larger sample size. In summary, a multivariate analysis of variance (MANOVA) was conducted to analyze the effect of the independent variable of age on the combined dependent variables of compatible, incompatible and Simon Effect test scores. The results have indicated that the multivariate effect of economic status was not statistically significant with Pillai's Trace = .226, Wilks' Lambda = .774, Hotelling's Trace = .291, and Roy's Largest Root = .291, all with $F(3, 13) = 1.262$, $p = .328$, $\eta^2 = .226$. Despite being not statistically significant, the effect size on economic status as an independent variable was large, indicating a meaningful proportion of variance explained by economic status.

Tests of between-subject effects were also conducted to analyze the effect of economic status on each of the dependent variables individually. For the compatible scores, the effect of economic status was not statistically significant as the p-value of .330 surpassed the standard threshold of .05. However, the Partial Eta Squared value of .138 just reaches the cutoff point of .1379 for a large effect size, indicating practical significance for more studies. The incompatible scores also show that the effect of economic status was statistically insignificant with a p-value of .161 but the Partial Eta Squared value of .216 displays a large effect size and implies strong

practical effect. Additionally, the Simon Effect results produced the p-value of .498, stating that there is no statistically significant effect of economic status. Its Partial Eta Squared value is also lower than that of the compatible and incompatible scores, showing a moderate effect size with a value of .089. To sum up, a series of univariate ANOVA tests were conducted to analyze the effect of economic status on each dependent variable of compatible, incompatible and Simon Effect scores individually. The effect of economic status on compatible scores was observed to be insignificant, $F(2, 16) = 1.196$, $p = .330$, with a large effect size, $\eta^2 = .138$. The effect of economic status on incompatible scores was also statistically insignificant, $F(2, 16) = 2.07$, $p = .161$, with a large effect size, $\eta^2 = .216$. The effect of economic status on the Simon Effect was found to be statistically insignificant as well, $F(2, 16) = .731$, $p = .498$, with a moderate effect size, $\eta^2 = .089$. Table 46 shows the effect of economic status on each dependent variable for better understanding.

Table 46

Effect of economic status as an independent variable on the dependent variables of compatible, incompatible and Simon Effect scores individually

	Compatible Score	Incompatible Score	Simon Effect Score
P-value	.330 (not significant)	.161 (not significant)	.498 (not significant)
Partial Eta Squared (η^2)	.138 (large effect size)	.216 (large effect size)	.089 (moderate effect size)

To conclude, it can be observed that the independent variable of economic stauts does not affect the dependent variables of compatible scores, incompatible scores and Simon Effect scores of the participants. Nevertheless, the effect sizes of compatible and incompatible scores was

proved to be large which encourages researchers to investigate this independent variable more with a larger sample size.

5.5.1.4 Significance of Language Group

For the last independent variable of language group in terms of multilinguals and bilinguals or monolinguals, the multivariate effect has proved to be statistically insignificant as well with all four tests displaying a p-value of .328 which is more than .005. In terms of effect size, the Partial Eta Squared values were at .226, showing a large effect size that implies high practical significance for more research. To conclude, a multivariate analysis of variance (MANOVA) was conducted to analyze the effect of the independent variable of language group on the combined dependent variables of compatible, incompatible and Simon Effect test scores. The results have indicated that the multivariate effect of economic status was not statistically significant with Pillai's Trace = .389, $F (6, 28) = 1.128$, $p = .372$, $\eta^2 = .195$; Wilks' Lambda =. 643, $F (6, 26) = 1.073$, $p = .404$, $\eta^2 = .198$; Hotelling's Trace = .507, $F (6, 24) = 1.013$, $p = .440$, $\eta^2 = .202$; and Roy's Largest Root = .373, $F (3, 14) = 1.742$, $p = .204$, $\eta^2 = .272$. Despite being not statistically significant, the effect size on economic status as an independent variable was large, indicating a meaningful proportion of variance explained by economic status.

Another analysis was conducted known as tests of between-subject effects to interpret the effect of language groups on each of the dependent variables individually. It was observed that the effect of language group on compatible scores was statistically insignificant with a p-value of .191, surpassing the significance cutoff point of .05. The Partial Eta Squared value of .111 shows a moderate effect size with considerable practical effort. Furthermore, the incompatible scores also show that there is no statistically significant effect of language group with a p-value of .512 while

the Partial Eta Squared shows a moderate effect size of .029 that borders more on weaker practical effort. Similarly, the effect of language group on the Simon Effect has proved to be not statistically significant as the p-value is .420. The Partial Eta Squared also displays a moderate effect size but leans more towards the cutoff point of a strong effect size. As a whole, a series of univariate ANOVA tests were conducted to analyze the effect of language group on each dependent variable of compatible, incompatible and Simon Effect scores individually. The effect of language group on compatible scores was observed to be insignificant, $F(1, 16) = 1.873$, $p = .191$, with a moderate effect size, $\eta^2 = .111$. The effect of language group on incompatible scores was also statistically insignificant, $F(1, 16) = .451$, $p = .512$, with a moderate effect size, $\eta^2 = .029$. The effect of language group on the Simon Effect was found to be statistically insignificant as well, $F(1, 16) = .687$, $p = .421$, with a moderate effect size, $\eta^2 = .044$. Table 47 shows the effect of language group on each dependent variable for better understanding.

Table 47

Effect of language group as an independent variable on the dependent variables of compatible, incompatible and Simon Effect scores individually

	Compatible Score	Incompatible Score	Simon Effect Score
P-value	.191 (not significant)	.512 (not significant)	.420 (not significant)
Partial Eta Squared (η^2)	.111 (moderate effect size)	.029 (moderate effect size)	.044 (moderate effect size)

As a result, this study shows that the independent variable of language group does not affect the dependent variables of compatible scores, incompatible scores and Simon Effect scores of the

participants. Despite the effect sizes for the dependent variables being moderate, it still produced a relatively high practical effort and can be further investigated using larger sample sizes in future research.

5.5.2 Stroop Effect

Similar to the results of Simon Test, the results from the participants' attempt at the Stroop Test that focuses on response selection was analysed using MANOVA via SPSS. The tests were run according to the significance of three factors, which are language group, in which group 1.0 stands for multilinguals and group 2.0 refers to bilinguals or monolinguals; economic status in which group 1.0 represents the T20 participants, group 2.0 for the M40 participants, and group 3.0 for the B40 participants; and age as the participants range from 22 years old to 51 years old. . The analysed results are generated in terms of descriptive statistics (Appendix 23), multivariate tests (Appendix 24), and tests of between-subject effects (Appendix 25).

5.5.2.1 Mean Scores

The Stroop Test showed a higher mean reaction time throughout all the groups compared to the Simon Test. For the congruent scores, the lowest mean reaction time in terms of language groups was identified in the multilingual group (M = 930.07, SD: 147.22) while the bilinguals displayed a poorer performance (M = 977.33, SD = 242.16) with a much more inconsistent performance compared to the multilinguals. On the other hand, it was observed that the T20 group produced the lowest congruent mean scores (M = 903.5, SD = 12.02) despite the B40 group following closely behind (M = 903.89, SD = 92.62), leaving the M40 group with the poorest performance (M = 987.30, SD = 235.93) when comparing the groups of economic status. In

essence, the multilingual and T20 group have shown a better overall performance in congruent conditions.

Moving on to the incongruent scores, it turned out that the bilingual group showed a lower mean score (M = 1002.5, SD = 204.56) despite having a larger standard deviation than the multilingual group that was not far behind (M = 1005.27, SD = 152.81). In terms of economic status, it can be seen that the B40 group displayed the best performance out of the three groups (M = 957.89, SD = 77.12), with the T20 group showing the lowest mean incongruent scores (1143, SD = 291.33) with a very diverse range of scores given the large standard deviation. As a result, it is evident that it is the bilingual and B40 group that produced the lowest mean scores when faced with incongruent stimuli. All in all, in terms of congruent and incongruent situations, it was found that the participants reacted better to congruent stimuli with a mean of 943.57 milliseconds compared to incongruent stimuli with a mean of 1004.48 milliseconds.

Finally, the Stroop Effect is also calculated by taking the incompatible score values away from the compatible score values. This study shows that the bilingual group produced a significantly better performance in the Stroop Task (M = 25.17, SD = 111.63) compared to the multilingual group (M = 75.2, SD = 128.95) with the bilinguals showing a more consistent performance as well. Additionally, the M40 group proved to have a better performance overall in the Stroop Test (M = 27.4, SD = 92.89) with the T20 group showing a relatively high mean Stroop Effect score (M = 259.5, SD = 279.31) with a very large difference between the scores of the two participants classified under the T20 group. To summarize, the bilinguals and the B40 group show an overall better performance in the Stroop Test. Table 48 and Table 49 show the scores of the different groups for clearer visualization.

Table 48

Mean compatible, incompatible and Stroop Effect scores of multilinguals and bilinguals (language group)

Group	Mean Congruent Score	Mean Incongruent Score	Mean Stroop Effect Score
Multilingual (1.0)	930.07	1005.27	75.20
Bilingual (2.0)	977.33	1002.50	25.17

Table 49

Mean compatible, incompatible and Stroop Effect scores of T20, M40 and B40 groups (economic status group)

Group	Mean Congruent Score	Mean Incongruent Score	Mean Stroop Effect Score
T20 (1.0)	903.50	1163.00	259.50
M40 (2.0)	987.30	1014.70	27.40
B40 (3.0)	903.89	957.89	54.00

5.5.2.2 Significance of Age

The multivariate tests were conducted to determine the significance of the effect of the independent variables on the dependent variables of congruent, incongruent and Stroop Effect scores as a whole. Firstly, this study will look at the significance of age as an independent factor. It has been observed that age has a significant multivariate effect with all four tests showing a p-value of .011, which is lesser than the standard threshold of .05, The Partial Eta Squared value also

showed a large effect size with a value of .475, indicating that 47.5% of variances in the combined dependent variables are associated with the independent variable of age. As a result, a multivariate analysis of variance (MANOVA) was conducted to analyze the effect of the independent variable of age on the combined dependent variables of compatible, incompatible and Simon Effect test scores. The results have indicated that the multivariate effect of age was statistically significant with Pillai's Trace = .475, Wilks' Lambda = .525, Hotelling's Trace = .907, and Roy's Largest Root = .907, all with $F(2, 14) = 6.346$, $p = .011$, $\eta^2 = .475$. Thus, this study concludes that age has a significant multivariate effect on the combined dependent variables of congruent, incongruent and Stroop Effect scores, with the participants aged 30 years old and above showing a poorer performance in the Stroop Task. Table 50 and Table 51 shows the overall congruent, incongruent and Stroop Effect mean scores of participants aged below 30 years and participants aged 30 years and above for better comparison.

Table 50

Congruent, incongruent and Stroop Effect scores of participants below 30 years old according to age and groups

Group	Age (year)	Congruent Scores (ms)	Incongruent Scores (ms)	Stroop Effect (ms)
Multilingual	22	911	1051	140
Multilingual	22	1234	1270	36
Multilingual	26	1032	968	-64
Multilingual	22	871	991	120
Multilingual	22	913	902	-11

Multilingual	22	862	906	44
Multilingual	22	1197	1112	-85
Multilingual	23	683	783	100
Multilingual	24	967	1013	46
Multilingual	21	896	939	43
Multilingual	23	943	1052	109
Multilingual	22	695	865	170
Multilingual	22	940	901	-39
Bilingual	22	796	786	-10
Bilingual	24	721	846	125
Bilingual	21	1259	1154	-105
Bilingual	22	880	841	-39
Mean value (x̄)	**22.47**	**929.41**	**963.53**	**34.12**

Table 51

Congruent, incongruent and Stroop Effect scores of participants 30 years old and above according to age and groups

Group	Age (years)	Congruent Scores (ms)	Incongruent Scores (ms)	Stroop Effect (ms)
Multilingual	51	912	1369	457
Multilingual	36	895	957	62
Bilingual	38	1296	1282	-14

Bilingual	35	912	1106	194
Mean value (x̄)	**40**	**1003.75**	**1178.50**	**699.00**

Furthermore, the tests of between subject effects that were used to analyze the effect of the independent variable on age whether significant or not on the three dependent variables individually. The congruent scores showed a statistically insignificant effect of age with a p-value of .376 that exceeds the cutoff point of .05, with the Partial Eta Squared value of .053 also indicating a small effect size as it was lower than .0588. This shows that there is weak practical effort in further investigating the effect of age on congruent scores. Next, the incongruent scores show a p-value of .017 which shows that the effect of age on incongruent scores is statistically significant, having exceed the standard threshold of .05. Additionally, the overall Stroop Effect score proved to be not statistically significant but approaching significance with a p-value of .063 that is close to .05. The Partial Eta Squared value of .212 also implies a large effect size and can be given more attention in future research. In a nutshell, a series of univariate ANOVA tests were conducted to analyze the effect of age on each dependent variable of congruent, incongruent and Stroop Effect scores individually. The effect of age on congruent scores was observed to be insignificant, $F (1, 16) = .832$, $p = .376$, with a small effect size, $\eta^2 = .053$. The effect of age on incongruent scores showed statistical significance, $F (1, 16) = 7.25$, $p = .017$, with a large effect size, $\eta^2 = .326$. The effect of age on the Stroop Effect was found to be statistically insignificant despite approaching significance, $F (1, 16) = 4.046$, $p = .063$, with a large effect size, $\eta^2 = .212$. Table 45 shows the effect of age on each dependent variable for better understanding.

Table 52

Effect of age as an independent variable on the dependent variables of congruent, incongruent and Stroop Effect scores individually

	Congruent Score	Incongruent Score	Stroop Effect Score
P-value	.376 (not significant)	.017 (significant)	.063 (marginally non-significant)
Partial Eta Squared (η^2)	.053 (small effect size)	.326 (large effect size)	.212 (small effect size)

In conclusion, the independent variable of age significantly affects the incongruent scores in the Stroop Test but not the congruent and Stroop Effect scores of the participants. As mentioned above, the older participants have been observed to display a poorer performance in the Stroop Test, specifically in incongruent conditions. Furthermore, the effect sizes for incongruent scores and Stroop Effect scores are considerably large, implying a strong practical effect for future research with a larger sample size.

5.5.2.3 Significance of Economic Status

When analyzing the independent variable of economic status, the four significance tests showed different p-values that were all more than .05, indicating that the multivariate effect is not statistically significant. In terms of the Partial Eta Squared values, all four tests showed a moderate effect size that did not exceed the value of .1379. To sum it up, a multivariate analysis of variance (MANOVA) was conducted to analyze the effect of the independent variable of age on the combined dependent variables of compatible, incompatible and Simon Effect test scores. The

results have indicated that the multivariate effect of economic status was not statistically significant with Pillai's Trace = .132, F (4, 30) = .532, p = .713, η^2 = .066; Wilks' Lambda = .868, F (4, 28) = 1.262, p = .726, η^2 = .068; Hotelling's Trace = .152, F (4, 26) = 1.262, p = .741, η^2 = .07; and Roy's Largest Root = .149, F (2, 15) = 1.262, p = .354, η^2 = .129. Despite being not statistically significant, the effect size on economic status as an independent variable was large, indicating a meaningful proportion of variance explained by economic status.

The tests of between-subjects effects were also run to interpret whether the effect of economic status on congruent, incongruent and Stroop Effect scores individually were significant or not. Regarding the congruent scores, the effect of economic status was proved to be statistically insignificant with the p-value of .525, surpassing the .05 cutoff point. However, the Partial Eta Squared value of .082 shows a moderate effect size, thus indicating that there may be practical effort in further research. Next, the incongruent scores were also shown to be statistically insignificant as the p-value pf .128 also exceeds the standard threshold. The effect size was also moderate with the Partial Eta Squared value of .128 which as an indication of potential practical effects. Lastly, the Stroop Effect scores with a p-value of .974 was deemed to be statistically insignificant with the Partial Eta Squared value of .003, implying a small effect size with very weak practical effort as only 0.3% of variances in the Stroop Effect scores are explained by the independent variable of economic status. To summarize, a series of univariate ANOVA tests were conducted to analyze the effect of economic status on each dependent variable of congruent, incongruent and Stroop Effect scores individually. The effect of economic status on congruent scores was observed to be insignificant, F (2, 16) = .673, p = .525, with a moderate effect size, η^2 = .082. The effect of economic status on incongruent scores was also statistically insignificant, F (2, 16) = 1.099, p = .359, with a moderate effect size, η^2 = .128. The effect of economic status on

the Stroop Effect was found to be statistically insignificant as well, F (2, 16) =.026, p =.974, with a small effect size, η^2 = .003. Table 3 shows the effect of economic status on each dependent variable for better understanding.

Table 53

Effect of economic status as an independent variable on the dependent variables of congruent, incongruent and Stroop Effect scores individually

	Congruent Score	Incongruent Score	Stroop Effect Score
P-value	.525 (not significant)	.359 (not significant)	.974 (not significant)
Partial Eta Squared (η^2)	.082 (moderate effect size)	.128 (moderate effect size)	.003 (small effect size)

In brief, it is evident that the independent variable of economic status does not have statistically significant effect on the congruent scores, incongruent scores and Stroop Effect scores of the participants. Moreover, the effect sizes produced are also moderate, which indicates medium practical effect for further research.

5.5.2.4 Significance of Language Group

The analysis for the third independent variable of language groups which involve the two groups of multilinguals and bilinguals has also showed that the multivariate effect is not statistically significant, with the p-values of each test being .313, which is significantly higher than .05. In terms of effect size, the Partial Eta Squared values for all four tests are at .153, demonstrating a large effect size with much potential for deeper research. As the results show, a

multivariate analysis of variance (MANOVA) was conducted to analyze the effect of the independent variable of language group on the combined dependent variables of congruent, incongruent and Stroop Effect test scores. The results have indicated that the multivariate effect of age was statistically insignificant with Pillai's Trace = .153, Wilks' Lambda = .847, Hotelling's Trace = .180, and Roy's Largest Root = .180, all with $F(2, 14) = 1.263$, $p = .313$, $\eta^2 = .153$. Nonetheless, the effect size on language group as an independent variable was large, implying a strong practical effort in further investigation.

Similarly to the other two independent variables, the tests of between-subjects have produced the analysis of the effect of language groups on each of the dependent variables specifically. It was found that the congruent scores showed a p-value of .829, proving the effect of language groups to be statistically insignificant while its Partial Eta Squared also showed a value of .003, implying a small effect size with weak to no practical effort. Additionally, the incongruent scores were observed to be not statistically significant as the p-value was .304, a value well above the cutoff point of .05. Its Partial Eta Squared value, however, showed improvement with a value of .07, indicating a moderate effect size with considerable practical effort for future studies. Finally, the Stroop Effect scores proved to be statistically insignificant with a p-value of .310 and a moderate effect size with a Partial Eta Squared value of .069. All in all, a series of univariate ANOVA tests were conducted to analyze the effect of language group on each dependent variable of congruent, incongruent and Stroop Effect scores individually. The effect of language group on congruent scores was observed to be insignificant, $F(1, 16) = .048$, $p = .829$, with a small effect size, $\eta^2 = .003$. The effect of language group on incongruent scores was also statistically insignificant, $F(1, 16) = 1.131$, $p = .304$, with a moderate effect size, $\eta^2 = .070$. The effect of language group on the Stroop Effect score was found to be statistically insignificant as well, F (1,

16) =1.104, p =.310, with a moderate effect size, η^2 = .069. Table 54 shows the effect of language group on each dependent variable for better understanding.

Table 54

Effect of language group as an independent variable on the dependent variables of congruent, incongruent and Stroop Effect scores individually

	Congruent Score	Incongruent Score	Stroop Effect Score
P-value	.829 (not significant)	.304 (not significant)	.310 (not significant)
Partial Eta Squared (η^2)	.003 (small effect size)	.070 (moderate effect size)	.069 (moderate effect size)

To conclude, the independent variable of language group does not have any significant effect on the dependent variables of congruent, incongruent and Stroop Task scores of the participants in this study. As the effect sizes range from small to moderate, the practical effort is also ranged weak to moderately strong which may not produce considerable potential for future studies.

5.5.3 Conclusion of Research Question 3

In terms of Simon Effect, the multilinguals showed a better performance with a lower mean score compared to the bilinguals. However, the independent variables of age, economic status and language group did not have any statistically significant effect on the outcome of these results despite the B40 group also showing a better performance in terms of economic status. Nonetheless, the effect sizes for age and economic status are large while the effect size for language group is moderate, showing potential in future research regarding these independent variables with a larger

sample size. Furthermore, the participants were seen to perform better in incompatible tasks rather than compatible tasks.

For the Stroop Effect, it was observed that the bilinguals showed an overall better performance, and lower mean scores compared to the multilingual group. Regardless, all three independent variables were observed to have a statistically insignificant effect on the participants' Stroop Effect scores. Despite the B40 group also showing the lowest mean score out of the three economic status groups, it was observed that it was the independent variable of age showed marginal non-significant effect on the Stroop Effect scores and significant effect on the incongruent scores. Additionally, the effect sizes for age are large and the marginally non-significance of its effect on Stroop Effect scores calls for further research to be conducted with larger sample sizes as it demonstrates strong practical effort. On the other hand, economic status and language group show small to moderate effect sizes, which poses slightly weaker motivation for future research due to less potential. However, the response times for Stroop Task was significantly longer compared to that of the Simon Task in both multilinguals and bilinguals. Moreover, the incongruent trials saw a slower response time overall compared to the congruent trials.

To address the fact that multilinguals were able to perform better than bilinguals in the Simon Task but not in the Stroop Task, it may be explained by the ability to suppress irrelevant interference better in the Stroop Task as bilinguals or monolinguals have more control over the languages they speak due to only having to switch between two or only one language compared to the multilinguals who use three or more languages where they have weaker interference control as they constantly switch between three or more languages due to greater lexical competition. Additionally, it can also be due to individual differences as a comparison between bilinguals and

multilinguals would suggest that there are no differences between each individual aside from the number of languages they have acquired. According to Bruin et. al. (2021), the individual differences and personal language experiences can influence their executive functioning and need to be taken into consideration. However, comparisons regarding different results between language groups in inhibition tasks do not show consistent evidence which makes it unclear what type of task-specific interference resolution would multilingualism have an impact on (Bruin et. al. 2021).

Next, this section will address the large difference in the overall response times between Simon Task and Stroop Task. According to Scerrati et. al. (2017), the Simon Task and Stroop Task were classified into different categories of stimuli by Kornblum (1992) in terms of stimulus-response ensembles. The ensembles showed the characteristics of dimensional overlaps between three dimensions: firstly, similarities in the relevant and irrelevant stimulus dimension; secondly, compatibility of the relevant stimulus dimension and the response dimension; and thirdly, the compatibility of the irrelevant stimulus dimension and response dimension (Liu et. al., 2004). The Simon Task is categorized as a Type 3 stimulus-response ensemble in which there is no overlap between the response dimension with the relevant stimulus dimension but instead it overlaps with the irrelevant stimulus dimension (Liu et. al., 2004). In simple terms, the relevant stimuli in the Simon Task are the words ‘left’ and ‘right’ while the irrelevant stimuli are the positions of these two words on the left side of the screen or the right side. However, the relevant stimuli do not cause interference in choosing the correct key to press. Instead, it is the irrelevant stimuli of word position that affects the participants ability to choose the correct response. On the other hand, the Stroop Task is considered a Type 8 stimulus-response-ensemble as there is an overlap between relevant stimulus-response dimensions, irrelevant stimulus and response dimensions as well as the relevant and irrelevant stimulus dimensions (Liu et. al., 2004). As the print colour is the relevant

stimuli and the meaning of the word is the irrelevant stimuli, the overlap between relevant stimulus-response dimensions occurs when the participant responds correctly to the relevant stimulus of print colour. Irrelevant stimulus and response dimensions overlap due to the occurrence of the participants' response being based on the irrelevant stimulus of word meaning instead of print colour. Finally, the overlap between relevant and irrelevant stimulus dimensions happens when the print colour matches the meaning of the word and when it does not. Therefore, both tasks are considered to be different in terms of response conflict in which the Stroop Task would require stronger inhibition of interference due to the overlap in all three dimensions which causes a poorer performance by participants compared to the Simon Task.

Lastly, in the Simon task, incompatible tasks will require more attentional control than compatible tasks because the location and meaning of the word does not relate to each other which can interfere the selection of the accurate response. Similarly in the Stroop task, incongruent tasks are more taxing mentally as the print colour is not related to the word's meaning (Liu et. al., 2004). In more specific terms, incompatible or incongruent trials usually take longer to respond because the relevant and irrelevant stimulus dimensions do not overlap and activate competing response codes in the participants (Scerrati et. al., 2017). Consequently, the better performance in incompatible trials in the Simon Task may be because incompatible trials often occurred in sequence for a few times without changing before suddenly having one compatible trial then switching back to the incompatible trials. This may cause the participants to familiarize themselves with the incompatible stimuli so that when they are suddenly faced with the compatible stimuli, they were unable to respond as quickly as that of incompatible trials.

As a result, this study is not able to contribute to the debate of whether the bilingual advantage exists or not due to conflicting results in the Simon Task and Stroop Task. However, it

can help researchers to develop clearer theories in terms of which task-specific interference resolution may be impacted by multilingualism based on the results of multilinguals excelling in the Simon Task but had poorer performance compared to the bilinguals in the Stroop Task.

5.6 Phonological Interference and its correlation to executive functioning

Poarch and van Hell (2012) drew the hypothesis that if inhibitory processes are involved in language control in multilinguals and bilinguals, it takes on the assumption that nonlinguistic areas that require inhibitory control may also be affected such as in the Simon and Stroop Task where the participants are required to inhibit irrelevant responses. However, it was brought to attention that many studies on cognitive advantages in inhibition have utilized different designs and methodologies which did not converge on the same pattern (Hilchey & Klein, 2011). The results either showed a bilingual advantage in the response time of the executive functioning tasks or a lower prevalence in linguistic interference (Hilchey & Klein, 2011).

However, this study was unable to draw a relation between the prevalence of variants and executive functioning as there is no clear explanation for the great fluctuation in scores between the four groups of total variances. Moreover, the reaction times for the Mandarin Chinese-dominant speakers who showed the highest number of variants overall was also highly inconsistent throughout the group. Furthermore, it was observed that some participants have significantly larger or smaller Simon Task or Stroop Task scores compared to the others in the same category. Table 55 and 56 shows the number of variants produced in comparison to the Simon and Stroop Effect scores according to language group.

Table 55

Number of variants compared to Simon Effect and Stroop Effect scores in multilingual group

Number of variants	Mean number of variants	Mean Simon Effect score (ms)	Mean Stroop Effect score (ms)
Group 1 (0-10)	6.5	-7	-100
Group 2 (11-20)	15.3	-42	98.57
Group 3 (21-30)	25.7	-32.67	-52.00
Group 4 (31 and above)	34.0	-30	278.50

Table 56

Number of variants compared to Simon Effect and Stroop Effect scores in bilingual group

Number of variants	Mean number of variants	Mean Simon Effect score (ms)	Mean Stroop Effect score (ms)
Group 1 (0-10)	5.5	57.50	-67.50
Group 2 (11-20)	17.0	130.00	194.00
Group 3 (21-30)	24.7	22.25	-52.67

The only relation that can be concluded is that the group with the lowest number of variants, Group 1, produced the best performance in the Stroop Task in both multilinguals and bilinguals. This suggests that the bilingual advantage hypothesis is not relevant in this study as the advantage in the Stroop Task was consistent in both multilinguals and bilinguals in Group 1 of number of variants. Conversely, this points to the effect of English language proficiency as all participants who were classified in Group 1 in terms of lowest number of variants were English-dominant

speakers which showed consistent use of English in their daily lives. This prevalence in the Stroop Task can be due to the fact that they feel more comfortable in an English-speaking context as the instructions and both tasks were conducted entirely in English despite it being non-verbal. For the speakers that were dominant in Mandarin Chinese, Malay and Tamil or the other English-dominant speakers who were less proficient and had less consistent use of English, the unfamiliar language environment might have added to their cognitive load which made it more taxing for them to process relevant and irrelevant stimuli as well as block out interferences from other languages compared to those in Group 1. Additionally, their age ranged consistently from twenty-two years old to twenty-six years old unlike the other groups where there was at least one participant that was aged above thirty. As the analysis on the Simon and Stroop Tasks produced insignificant effects from all factors, except age being marginally non-significant in the Simon Task as well as the Stroop Task and had significant effect on the performance of participants in the incongruent trials in the Stroop Task, it further solidifies the assumption that age plays a role in affecting phonological interference as well.

Moving on, the analysis goes into detail regarding the prevalence of phonological interference between multilinguals and bilinguals as seen in Table 57.

Table 57

Total number of variants produced by multilinguals and bilinguals

Language Group	Number of Participants	Total Number of Variants	Mean Number of Variants
Multilingual	25	286	11.4
Bilingual	6	103	17.2

From the table, it is also evident that multilinguals produced less variants compared to bilinguals in the reading test despite showing a poorer performance in the Stroop Task. Nonetheless, it was also observed that the participants who showed the lowest number of variants overall were the ones who excelled in the Stroop Task regardless of language group as mentioned above. One of the factors affecting the prevalence of phonological interference can also be the level of English proficiency and the participants' individual language experience. This is because when looking at the participants other than the English-dominant speakers, it can be seen that majority of those from the multilingual group have a better grasp on English phonological rules compared to those in the bilingual group. As a result, this solidifies the conclusion from this study that the prevalence of phonological interference does not depend on the individual's executive functioning, but instead points towards the role of English proficiency, age and personal language experience. It also implies that the mechanisms that control language interference may not be the same as those that control non-linguistic inhibitory processes.

5.7 Limitations of study and recommendations for future research

Firstly, one of the biggest limitations of this study is its small sample size, especially since the number of English-, Mandarin Chinese-, Malay, and Tamil-dominant speakers are inequal as well as the fact that bilinguals were significantly lesser than multilinguals. In terms of analyzing segmental and suprasegmental interference, it may affect the accuracy of the results as it is generalized from the findings in a minimum of four and a maximum of seven participants from one specific language group. A larger sample size of at least 10 participants may be more reliable as there is already insufficient research on the phonological properties on Mandarin Chinese, Malay and Tamil to accurately relate the results on phonological variants to influences from their

L1. This limitation is more prominent in the study of executive functioning because a smaller sample size may limit statistical power. As seen in the independent variable of age, the statistical results were approaching significance but still considered insignificant and only one dependent variable in one out of two tests showed significant results. With a large sample size, the significance of the three different independent variables could have differing results as seen in the study done by Antón et. al. (2019). In future research, it is recommended to increase the sample size in order to improve generalizability and for better statistically powered results.

Next, this study is also limited due to overgeneralization of groups in terms of language experience. In a multilingual country like Malaysia where there is an abundance of languages and dialects used, the participants are exposed to languages and dialects that are not acquired by them, but they may pick up the characteristics of those languages and dialects over time. Moreover, it was found that participants in the bilingual group may only have acquired two or lesser languages, but in reality, they are constantly exposed to the other languages due to their friends, families or interactions with other Malaysians. For example, an English-dominant bilingual may have Malay friends who communicate in Malay, or their use of English contains traces of influence from Malay which can be unconsciously learned by the bilingual. Thus, this may also influence the classification of bilinguals, leading to conflicting results when attempting to relate the prevalence of phonological interference and executive functioning. In terms of this limitation, future researchers are recommended to specifically analyze language influence by including dialects or conduct analysis based on specific varieties such as by categorizing influence from Chinese as standard Mandarin Chinese or from the Cantonese dialect to obtain high precision in results.

Lastly, it was found that the responses from the Language Experience and Proficiency Questionnaire (LEAP-Q) did not accurately reflect on the actual accuracy of English language use

in the reading tests. Questions that required deeper analysis of the participants' own usage of English such as age of acquiring and achieving fluency in English as well as self-reported proficiency in speaking, reading and understanding spoken English required prompting from the researcher to be more specific and provide an accurate report as the participants were more interested in finishing the questionnaire rather than providing quality responses. Moreover, the participants were also observed to provide their answers with less focus and accuracy throughout the survey as it required them to answer seven questions that also contained sub-questions for each of their acquired languages. In essence, language dominance that is self-reported may not accurately show the speaker's actual fluency or accuracy in using the language. Thus, this study recommends future research to implement the use of formal tests with a standardized scoring system such as MUET or IELTS to categorize levels of proficiency instead of relying on the participants' self-report. If no formal tests are available to be implemented, the researcher should conduct interviews with the participants to cross-check with their self-reports to achieve a somewhat more accurate report of their language proficiency.

5.8 Conclusion

To conclude this study, it was found that Mandarin Chinese-dominant speakers produce the highest number of phonological variants while English-dominant speakers show the lowest amount. Furthermore, the prevalence of reinterpretation of differences is the greatest compared to overdifferentiation, substitution of sounds and underdifferentiation, which was also the lowest-occurring type of interference. In terms of executive functioning, there was no evidence to support the bilingual advantage hypothesis as the multilinguals showed better response times in the Simon Task but displayed a poorer performance in the Stroop Task compared to bilinguals. It was also

found that the prevalence of phonological variants did not correlate with the participants' executive functioning, but possible factors could be in regard to personal language experience and English proficiency as well as age.

As a result of these findings and its limitations, future researchers can take note of the recommended ways to increase reliability and precision of their own research in order to broaden the scope of knowledge in phonological interference and executive findings in Malaysia. As a country rich with culture and languages, it is important to understand how these cultures and exposure to the languages can affect one's perception of English as it will not only contribute to understanding the individual's own causes of phonological errors, but also enrichen the corpus of phonology in Asian English and develop language learning strategies that correspond to the dominant languages and the effects on English phonology that may come with it. Additionally, executive functioning in the Malaysian context is unique as there are not many countries where the people are exposed and communicate in up to three languages in which some are proficient in more than three. This will no doubt have some effect on executive functioning which makes this field of research crucial to creating interventions for cognitive disorders than affect executive functioning or simply improving one's brain plasticity.

All in all, this study contributes to the empirical study of phonological interference as are not many studies based in Malaysia and studies in Malaysia context typically investigate the types of interference based on Malaysian English as a whole or focus on one particular group of speakers of the same dominant language. Despite having conflicting results in terms of executive functioning, this study contributes to the sense that it gives more evidence that the bilingual advantage hypothesis does not exist and pushes for more detailed and intensive analysis of neurocognitive mechanisms in terms of not only inhibition but also working memory and shifting.

As the concept of bilingualism, let alone multilingualism, and all its theories as well as its relation to cognitive mechanisms such inhibiting interference be it linguistic or non-linguistic, is still in its infancy (Bruin et. al., 2021) and requires deeper and more diverse research to build the database in this field. Therefore, future research should focus on considering different factors, situations, tasks, as well as target different cognitive and neural mechanisms that are involved or not involved in language control in order to produce clearer theories and precise results.

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Appendix

Appendix 1

Test 1: Read out the words listed clearly.

a. Careful style (body language – straight and formal)

   Q1. What are your strengths and weaknesses?

   Q2. Where do you see yourself in 10 years?

   Q3. What defines a successful person?

   Q4. If you could remove one word from the English language forever, which would it be and why?

b. Casual style (change body language to more relax and friendly to make the participant feel comfortable in order to elicit a more casual way of speaking)

   Q1. What is your favorite movie or TV series and why?

   Q2. What are your weekend plans?

   Q3. What kind of food do you like and don't like?

Appendix 2

c. Reading style

Mrs.Randal: How is your husband, Ruth?

Mrs.Reed: Not very well, unfortunately, he fell from the roof last Wednesday and broke his ribs.

Mrs.Randal: Oh no, I'm terribly sorry to hear that! How many did he break?

Mrs.Reed: Twelve!

Mrs.Randal: I hope he recovers soon. Are all the children grown up now, Ruth?

Mrs.Reed: Oh, yes. Laura is the cleverest one. She's a librarian in the public library.

Mrs.Randal: Very interesting. And what about Rita?

Mrs.Reed: She's a secretary at the railway station.

Mrs.Randal: And what about Rosemary? She was always a very pretty child.

Mrs.Reed: Rosemary is a waitress in a restaurant in Paris. She's married to an electrician.

Mrs.Randal: And what about Roland?

Mrs.Reed: Roland is a pilot. This is his third year working with Cathay Pacific Airlines.

Mrs.Randal: Really? Which countries does he fly to?

Mrs.Reed: Australia and America.

Mrs.Randal: It's so good to hear that all your children are doing well!

Mrs.Reed: Thank you! How about your own children? Let me buy you a bottle of juice while you tell me all about your Kathy and Victor.

Appendix 3

d. Word list style

1. mouth
2. think
3. usual
4. free
5. west
6. halve
7. white
8. squirm
9. lovely
10. glass
11. film
12. road
13. little
14. pray
15. thunder
16. clever
17. pencil

Appendix 4

e. Minimal pair style

1. Ship / Sheep
2. Bit / Beat
3. Pat / Pet
4. Tin / Thin
5. Breeze / Breathe
6. Van / When
7. Day / They
8. Tree / Three
9. Mouse / Mouth
10. Dock / Dog
11. Mop / Mob
12. Whizz / With

Appendix 5

Test 2: Stress pattern tests for suprasegmental interference

a. Polysyllabic words

1. Comfortable
2. Interesting
3. Delicious
4. Dilemma
5. Responsibility
6. Banana
7. Vocabulary
8. Economy
9. Tomato
10. Facility
11. Invisible
12. International
13. Electricity
14. Alternative
15. Develop
16. Complicated

Appendix 6

b. Compound words

1. Airport
2. Handshake
3. Firefighter
4. Football
5. Toothbrush
6. Cupcake
7. Grandmother
8. Butterfly
9. Newspaper
10. Jellyfish
11. Pineapple
12. Waterfall

Appendix 7

c. Phrases / Sentences

i. We need to finish the project overnight, not over the weekend.

ii. You should buy food at the supermarket and not at the convenience store, because it will be much cheaper.

iii. Mary's flight arrives at six in the morning, not six in the evening.

iv. The email was meant for John, but Sarah was the one who received it.

v. Question: What did Mary do?

Answer: Mary bought a book about caterpillars.

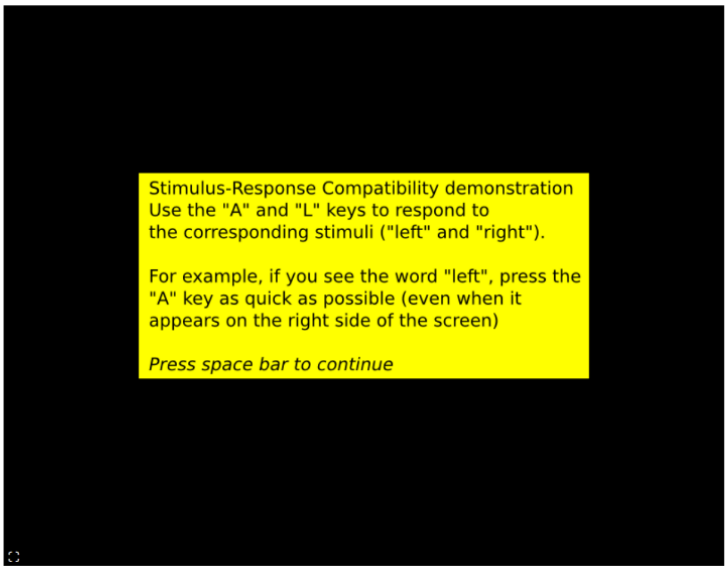
Question: What did Mary buy?

Answer: Mary bought a book about caterpillars.

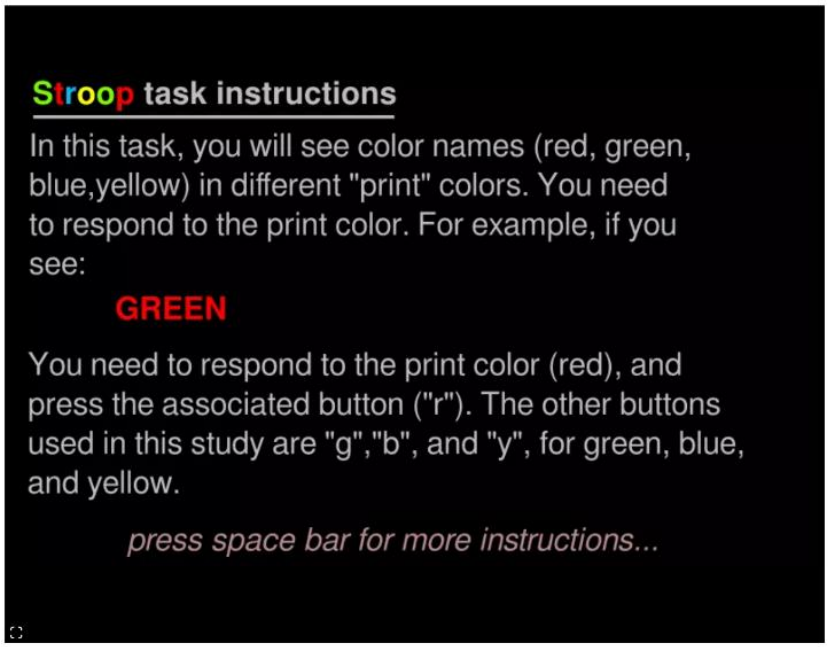
Question: What kind of book did Mary buy?

Answer: Mary bought a book about caterpillars.

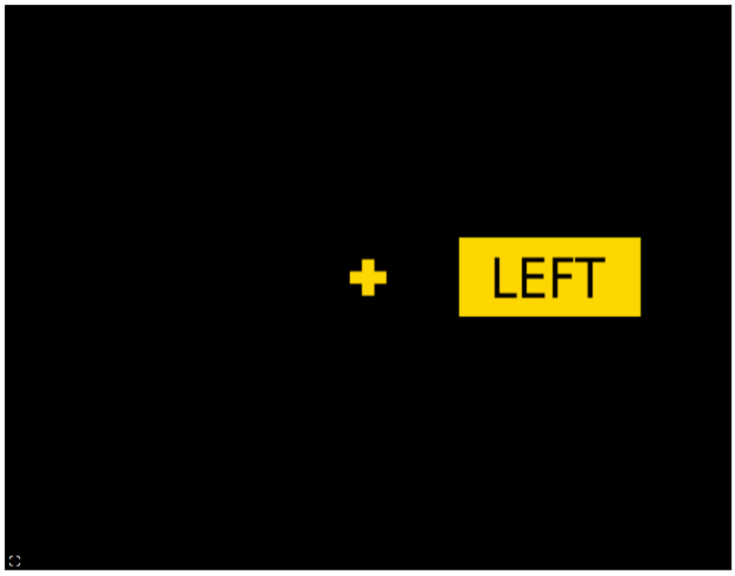
Appendix 8



Appendix 9



Appendix 10



Appendix 11

Appendix 12

Table 1 Phonology of English, Mandarin, Malay and Tamil

	English	Mandarin	Malay	Tamil
Primary consonants	24 consonants b, p, d, t, g, k, v, f, ð, θ, z, s, ʒ, ʃ, h, m, n, ŋ, l, ɹ, dʒ, tʃ, j, w	25 consonants p, pʰ, t, tʰ, k, kʰ, f, s, ʂ, ɕ, x, ts, tsʰ, tʂ, tʂʰ, tɕ, tɕʰ, m, n, ŋ, l, ɻ, j, w, ɥ	19 consonants b, p, d, t, g, k, ʔ, s, h, m, n, ŋ, ɲ, l, r, dʒ, tʃ, j, w	16 consonants p, t, k, ɻ, tʃ, m, n, ɳ, ɲ, r, ɾ, l, ɭ, ʋ, ɻ, j
	24 syllable-initial consonants b, p, d, t, g, k, v, f, ð, θ, z, s, ʒ, ʃ, h, m, n, ŋ, l, ɹ, dʒ, tʃ, j, w	24 syllable-initial consonants p, pʰ, t, tʰ, k, kʰ, f, s, ʂ, ɕ, x, ts, tsʰ, tʂ, tʂʰ, tɕ, tɕʰ, m, n, l, ɻ, j, w, ɥ	18 syllable-initial consonants b, p, d, t, g, k, s, h, m, n, ŋ, ɲ, l, r, dʒ, tʃ, j, w	13 syllable-initial consonants p, t, k, ɻ, tʃ, m, n, ɳ, ɲ, ɾ, l, ʋ, j
	20 syllable-final consonants b, p, d, t, g, k, v, f, ð, θ, z, s, ʒ, ʃ, m, n, ŋ, l, dʒ, tʃ	2 syllable-final consonants n, ŋ	9 syllable-final consonants p, t, ʔ, s, h, m, n, ŋ, l	8 syllable-final consonants m, n, ɳ, l, ɭ, ɻ, j, r
Marginal consonants*	None	None	8 consonants v, f, ð, θ, ʃ, z, x, ɣ	9 consonants b, d, ɖ, g, dʒ, ŋ, f, ʃ, s, h
Clusters	*Initial consonant clusters* 41 with CCV-structures 10 with CCCV-structures	None	None (apart from loan words from English)	*Initial consonant clusters* 15 with CCV-structures
	Final consonant clusters 59 with –VCC structures 49 with –VCCC structures	None	None	*Final consonant clusters* 7 with VCC structures (in loan words only)
Syllable structures	$[C_{0-3}]$ –V– $[C_{0-4}]$	$[C_{0-1}]$ –V– $[C_{0-1}]$	$[C_{0-1}]$ –V– $[C_{0-1}]$	$[C_{0-2}]$ –V– $[C_{0-2}]$

Note: * Marginal consonants are consonants that occur only in loan words.

Appendix 13

Pinyin	b	p	m	f	d	t	n	l	g	k	h	j	q	x	z	C	s	zh	ch	sh	r
IPA	[p]	[pʰ]	[m]	[f]	[t]	[tʰ]	[n]	[l]	[k]	[kʰ]	[x]	[tɕ]	[tɕʰ]	[ɕ]	[ts]	[tsʰ]	[s]	[tʂ]	[tʂʰ]	[ʂ]	[ɻ]

Table 4: Mandarin Chinese consonant sounds in both Pinyin and IPA

Appendix 14

Table 2. The consonant inventory of Malay.

	Place of articulation						
Manner	Labial	Labio-dental	Lingua-dental	Alveolar	Palatal	Velar	Glottal
Stops	p b			t d		k g	ʔ
Nasals	m			n	ə	ŋ	
Fricatives		(f) (v)	(θ) (ð)	s (z)	(ʃ)	h	(x) (ɣ)
Affricates				tʃ dʒ			
Liquids				r l			
Glides	w				j		

() Secondary consonants.

Appendix 15

Manner \ Place	Labial	Dental	Alveolar	Retrofle x	Alveolo - palatal	Velar	Glottal
Nasal	m ம்	(n̪) ந்	n ன்	ɳ ண்	ɲ ஞ்	(ŋ) ங்	
Stop/Affricate	p ப்	t̪ த்	t:r ற்ற	ʈ ட்	t͡ɕ ~ t͡ʃ ச்	k க்	
Fricative	(f)		s ஸ (z)	(ʂ) ஷ்	(ɕ) ஶ்	(x)	(h) ஹ்
Tap			ɾ ர்				
Trill			r ற்				
Approximant	ʋ வ்			ɻ ழ்	j ய்		
Lateral approximant			l ல்	ɭ ள்			

Source: Keane (2004)

Appendix 16

Vowel sounds in pinyin	Description
a	Low
e	Central
o	Mid-back
i	High-front
u	High-back
ü	High-front

Table 2: Mandarin main vowel sounds in pinyin

Appendix 17

Table 1. Description of Malay Vowels According to Tongue Position and Height

Tongue Height	**Tongue Position**		
	Front	**Center**	**Back**
High	/i/		/u/
Mid-high	/e/	/ə/	/o/
Mid-low			
Low	/a/		

Appendix 18

	Short			Long		
	Front	**Central**	**Back**	**Front**	**Central**	**Back**
Close	i		u	i:		u:
	இ		உ	ஈ		ஊ
Mid	e		o	e:		o:
	எ		ஒ	ஏ		ஓ
Open		a		(æ:)	a:	(ɔ:)
		அ		ஐ	ஆ	ஔ

Figure 1 Tamil Vowels

Appendix 19

Pinyin	a	o	e	i	u	ü	ai	ao	ei	ia	iao	ie	Iu	ou	ua	uai	üe	ui	uo
IPA	[a]	[ɔ]	[ə]	[i]	[u]	[y]	[ja]	[au̯]	[ei̯]	[ja]	[jau̯]	[jɛ]	[jou̯]	[ou̯]	[ua]	[uai̯]	[ɥœ]	[uən]	[uɔ]
Pinyin	an	en	ian	in	uan	üan	un	ün	ang	eng	iang	ing	Iong	ong	uang	ueng	-i	-i	er
IPA	[an]	[ən]	[jɛn]	[in]	[uan]	[ɥɛn]	[uən]	[yn]	[aŋ]	[əŋ]	[jaŋ]	[iŋ]	[juŋ]	[uŋ]	[uaŋ]	[uəŋ]	[ɿ]	[ʅ]	[əɹ]

Table 5: Mandarin Chinese vowel sounds in both Pinyin and IPA

Appendix 20

Descriptive Statistics

	Economic Status	Group	Mean	Std. Deviation	N
Compatible Scores	1.0	1.0	616.000	9.8995	2
		Total	616.000	9.8995	2
	2.0	1.0	648.800	55.6390	5
		2.0	617.200	139.8917	5
		Total	633.000	101.7393	10
	3.0	1.0	677.250	107.0457	8
		2.0	574.000	.	1
		Total	665.778	105.8817	9
	Total	1.0	659.600	84.3334	15
		2.0	610.000	126.3598	6
		Total	645.429	97.4544	21
incompatible scores	1.0	1.0	581.500	10.6066	2
		Total	581.500	10.6066	2
	2.0	1.0	631.600	82.1450	5
		2.0	670.000	174.4334	5
		Total	650.800	130.1220	10
	3.0	1.0	636.500	147.6860	8
		2.0	557.000	.	1
		Total	627.667	140.6663	9
	Total	1.0	627.533	114.8744	15
		2.0	651.167	162.6953	6
		Total	634.286	126.3899	21
Simon Effect	1.0	1.0	-34.500	20.5061	2
		Total	-34.500	20.5061	2
	2.0	1.0	-17.200	82.3086	5
		2.0	70.200	82.3754	5
		Total	26.500	90.2703	10
	3.0	1.0	-40.750	96.8810	8
		2.0	-17.000	.	1
		Total	-38.111	90.9690	9
	Total	1.0	-32.067	82.3498	15
		2.0	55.667	81.8283	6
		Total	-7.000	89.8354	21

Appendix 21

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.381	2.665[b]	3.000	13.000	.091	.381
	Wilks' Lambda	.619	2.665[b]	3.000	13.000	.091	.381
	Hotelling's Trace	.615	2.665[b]	3.000	13.000	.091	.381
	Roy's Largest Root	.615	2.665[b]	3.000	13.000	.091	.381
Age	Pillai's Trace	.298	1.836[b]	3.000	13.000	.190	.298
	Wilks' Lambda	.702	1.836[b]	3.000	13.000	.190	.298
	Hotelling's Trace	.424	1.836[b]	3.000	13.000	.190	.298
	Roy's Largest Root	.424	1.836[b]	3.000	13.000	.190	.298
EconomicStatus	Pillai's Trace	.389	1.128	6.000	28.000	.372	.195
	Wilks' Lambda	.643	1.073[b]	6.000	26.000	.404	.198
	Hotelling's Trace	.507	1.013	6.000	24.000	.440	.202
	Roy's Largest Root	.373	1.742[c]	3.000	14.000	.204	.272
Group	Pillai's Trace	.226	1.262[b]	3.000	13.000	.328	.226
	Wilks' Lambda	.774	1.262[b]	3.000	13.000	.328	.226
	Hotelling's Trace	.291	1.262[b]	3.000	13.000	.328	.226
	Roy's Largest Root	.291	1.262[b]	3.000	13.000	.328	.226
EconomicStatus * Group	Pillai's Trace	.104	.501[b]	3.000	13.000	.688	.104
	Wilks' Lambda	.896	.501[b]	3.000	13.000	.688	.104
	Hotelling's Trace	.116	.501[b]	3.000	13.000	.688	.104
	Roy's Largest Root	.116	.501[b]	3.000	13.000	.688	.104

a. Design: Intercept + Age + EconomicStatus + Group + EconomicStatus * Group

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

Appendix 22

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Compatible Scores	40182.080[a]	5	8036.416	.805	.564	.212
	incompatible scores	82055.133[b]	5	16411.027	1.037	.432	.257
	Simon Effect	46860.417[c]	5	9372.083	1.227	.344	.290
Intercept	Compatible Scores	70265.093	1	70265.093	7.038	.018	.319
	incompatible scores	23751.381	1	23751.381	1.501	.239	.091
	Simon Effect	6058.591	1	6058.591	.793	.387	.050
Age	Compatible Scores	21206.037	1	21206.037	2.124	.166	.124
	incompatible scores	64056.547	1	64056.547	4.047	.063	.212
	Simon Effect	5816.017	1	5816.017	.762	.397	.048
EconomicStatus	Compatible Scores	23885.852	2	11942.926	1.196	.330	.138
	incompatible scores	65517.275	2	32758.638	2.070	.161	.216
	Simon Effect	11162.920	2	5581.460	.731	.498	.089
Group	Compatible Scores	18699.118	1	18699.118	1.873	.191	.111
	incompatible scores	7137.709	1	7137.709	.451	.512	.029
	Simon Effect	5249.184	1	5249.184	.687	.420	.044
EconomicStatus * Group	Compatible Scores	316.620	1	316.620	.032	.861	.002
	incompatible scores	662.870	1	662.870	.042	.841	.003
	Simon Effect	884.160	1	884.160	.116	.738	.008
Error	Compatible Scores	149765.063	15	9984.338			
	incompatible scores	237433.153	15	15828.877			
	Simon Effect	114547.583	15	7636.506			
Total	Compatible Scores	8938086.000	21				
	incompatible scores	8768174.000	21				
	Simon Effect	162437.000	21				
Corrected Total	Compatible Scores	189947.143	20				
	incompatible scores	319488.286	20				
	Simon Effect	161408.000	20				

a. R Squared = .212 (Adjusted R Squared = -.051)

b. R Squared = .257 (Adjusted R Squared = .009)

c. R Squared = .290 (Adjusted R Squared = .054)

Appendix 23

Descriptive Statistics

	Economic Status	Group	Mean	Std. Deviation	N
Congruent Scores	1.0	1.0	903.500	12.0208	2
		Total	903.500	12.0208	2
	2.0	1.0	977.800	233.5609	5
		2.0	996.800	265.4462	5
		Total	987.300	235.9266	10
	3.0	1.0	906.875	98.5516	8
		2.0	880.000	.	1
		Total	903.889	92.6208	9
	Total	1.0	930.067	147.2221	15
		2.0	977.333	242.1633	6
		Total	943.571	174.1021	21
Incongruent Scores	1.0	1.0	1163.000	291.3280	2
		Total	1163.000	291.3280	2
	2.0	1.0	994.600	194.1824	5
		2.0	1034.800	210.9104	5
		Total	1014.700	192.2961	10
	3.0	1.0	972.500	67.9033	8
		2.0	841.000	.	1
		Total	957.889	77.1742	9
	Total	1.0	1005.267	152.8054	15
		2.0	1002.500	204.5637	6
		Total	1004.476	163.7311	21
Stroop Effect	1.0	1.0	259.500	279.3072	2
		Total	259.500	279.3072	2
	2.0	1.0	16.800	69.2221	5
		2.0	38.000	119.7518	5
		Total	27.400	92.8873	10
	3.0	1.0	65.625	84.4392	8
		2.0	-39.000	.	1
		Total	54.000	86.3423	9
	Total	1.0	75.200	128.9541	15
		2.0	25.167	111.6269	6
		Total	60.905	123.6608	21

Appendix 24

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.268	2.557[b]	2.000	14.000	.113	.268
	Wilks' Lambda	.732	2.557[b]	2.000	14.000	.113	.268
	Hotelling's Trace	.365	2.557[b]	2.000	14.000	.113	.268
	Roy's Largest Root	.365	2.557[b]	2.000	14.000	.113	.268
Age	Pillai's Trace	.475	6.346[b]	2.000	14.000	.011	.475
	Wilks' Lambda	.525	6.346[b]	2.000	14.000	.011	.475
	Hotelling's Trace	.907	6.346[b]	2.000	14.000	.011	.475
	Roy's Largest Root	.907	6.346[b]	2.000	14.000	.011	.475
EconomicStatus	Pillai's Trace	.132	.532	4.000	30.000	.713	.066
	Wilks' Lambda	.868	.514[b]	4.000	28.000	.726	.068
	Hotelling's Trace	.152	.493	4.000	26.000	.741	.070
	Roy's Largest Root	.149	1.114[c]	2.000	15.000	.354	.129
Group	Pillai's Trace	.153	1.263[b]	2.000	14.000	.313	.153
	Wilks' Lambda	.847	1.263[b]	2.000	14.000	.313	.153
	Hotelling's Trace	.180	1.263[b]	2.000	14.000	.313	.153
	Roy's Largest Root	.180	1.263[b]	2.000	14.000	.313	.153
EconomicStatus * Group	Pillai's Trace	.018	.131[b]	2.000	14.000	.879	.018
	Wilks' Lambda	.982	.131[b]	2.000	14.000	.879	.018
	Hotelling's Trace	.019	.131[b]	2.000	14.000	.879	.018
	Roy's Largest Root	.019	.131[b]	2.000	14.000	.879	.018

a. Design: Intercept + Age + EconomicStatus + Group + EconomicStatus * Group

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

Appendix 25

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Congruent Scores	67899.630[a]	5	13579.926	.378	.856	.112
	Incongruent Scores	235548.068[b]	5	47109.614	2.351	.092	.439
	Stroop Effect	144823.725[c]	5	28964.745	2.698	.062	.474
Intercept	Congruent Scores	195815.690	1	195815.690	5.456	.034	.267
	Incongruent Scores	84209.443	1	84209.443	4.202	.058	.219
	Stroop Effect	23202.001	1	23202.001	2.161	.162	.126
Age	Congruent Scores	29849.462	1	29849.462	.832	.376	.053
	Incongruent Scores	145298.830	1	145298.830	7.250	.017	.326
	Stroop Effect	43435.090	1	43435.090	4.046	.063	.212
EconomicStatus	Congruent Scores	48310.944	2	24155.472	.673	.525	.082
	Incongruent Scores	44035.455	2	22017.727	1.099	.359	.128
	Stroop Effect	563.645	2	281.822	.026	.974	.003
Group	Congruent Scores	1736.999	1	1736.999	.048	.829	.003
	Incongruent Scores	22663.108	1	22663.108	1.131	.304	.070
	Stroop Effect	11851.672	1	11851.672	1.104	.310	.069
EconomicStatus * Group	Congruent Scores	89.639	1	89.639	.002	.961	.000
	Incongruent Scores	1169.034	1	1169.034	.058	.812	.004
	Stroop Effect	1906.103	1	1906.103	.178	.679	.012
Error	Congruent Scores	538331.513	15	35888.768			
	Incongruent Scores	300609.170	15	20040.611			
	Stroop Effect	161016.085	15	10734.406			
Total	Congruent Scores	19303099.00	21				
	Incongruent Scores	21724578.00	21				
	Stroop Effect	383737.000	21				
Corrected Total	Congruent Scores	606231.143	20				
	Incongruent Scores	536157.238	20				
	Stroop Effect	305839.810	20				

a. R Squared = .112 (Adjusted R Squared = -.184)

b. R Squared = .439 (Adjusted R Squared = .252)

c. R Squared = .474 (Adjusted R Squared = .298)