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Tethering Effect as an Explanation for the Bottleneck in Second Language Acquisition

Chuan Qin

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	Dr. Lim Lisa Li Su Associate Professor School of English The University of Hong Kong
In-attendance:	Dr. Wee Lian Hee Associate Professor, Department of English Language and Literature, HKBU

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QIN Chuan

A thesis submitted in partial fulfilment of the requirements
for the degree of
Doctor of Philosophy

Principal Supervisor: Dr. WEE Lian-Hee
Hong Kong Baptist University
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DECLARATION

I hereby declare that this thesis represents my own work which has been done after registration for the degree of PhD at Hong Kong Baptist University, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications.

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ABSTRACT

A learner of L2 normally attains a certain level of competence which then stagnates, thereby rarely accomplishes native-like competence of the target-language (TL). This bottleneck effect is accounted for through the E-Tether Theory (ETT), which is the main thesis of this dissertation. The ETT argues that the L2 E-grammar of a learner's community exerts a centrifugal force that draws the I-grammar of the learner towards it. This force, christened as the "E-tether", stems from the learner's identification with his speech community and from the linguistic input provided by the local E-grammar. When the local E-grammar is not identical to the TL grammar, the E-tether is a double-edge sword that encourages the development of the L2 I-grammar in the initial stages, but then prevents the I-grammar from progression towards the TL. By considering how social environment affects the I-grammar of individual learners through E-languages, the ETT provides a more comprehensive account to the bottleneck effect.

The validity of the proposed ETT is examined in this dissertation through two empirical studies: (i) the acquisition of English consonant clusters by the native Cantonese speakers in Hong Kong, and (ii) the acquisition of the same structures by the native Cantonese speakers in Guangzhou. In the two studies, the ETT is tested by seeing whether the individuals in the two cities attitudinally incline towards the phonological patterns of Hong Kong English (HKE) and of Guangzhou English (GZE), which are the E-languages of the two communities. The E-grammar in each city is generalized from the productions of consonant clusters by 10 speakers and is analyzed under the framework of Optimality Theory; the attitudes towards the E-grammar are obtained through a language attitude test implemented to 129 participants in Hong Kong and 66 in Guangzhou. Two findings emerge from the results. First, there is a tendency in HKE and in GZE to produce syllabic obstruents and to devoice word-final obstruents. Both patterns are also attitudinally accepted by the participants in the two cities. Second, when there is more than one strategy in the local E-grammar to avoid consonant clusters, the one that better preserves intelligibility is more likely to be accepted. The observed acceptance of the L2 speakers towards the "non-standard" L2

patterns can hardly be explained if one does not acknowledge the role of the local E-grammar. The findings thus lend support to the ETT.

Besides the Hong Kong study and the Guangzhou study, there is evidence showing that the ETT can work in a range of social contexts, and can apply to domains other than phonological acquisition.

Keywords: *L2 acquisition; I-language; E-language*

DEDICATION AND ACKNOWLEDGEMENTS

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ABBREVIATIONS AND CONVENTIONS

Abbreviations and conventions related to the E-tether Theory

L1	first language
L2	second language
TL	target language
ETT	E-tether Theory
UG	Universal Grammar
OT	Optimality Theory
CDA	Constraint Demotion Algorithm
MISIB	Matched Interlanguage Speech Intelligibility Benefit
Native-like	achieving the competence of the native speakers of the TL
Linguistic input	the external learning data available to the L2 speakers
Input in OT	the underlying representations

Phonological abbreviations

[cor]	coronal
[cont]	continuant
[son]	sonorant

Item numbering

In this dissertation, all items are numbered in the following way: (C-x-y-z) where *C* refers to the chapter number; *x* to the item list in that chapter; *y* to a specific item and *z* to a sub-item.

E.g.	(6 -	12 -	a -	ii)
	↓	↓	↓	↓
	Chapter	Item list	Item	Sub-item

LIST OF OPTIMALITY THEORETIC CONSTRAINTS

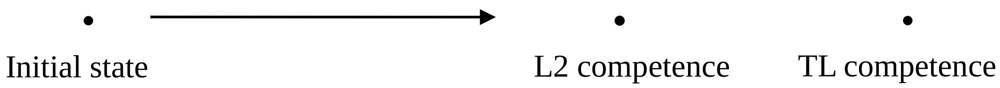
***CC**	Do not have consonant clusters in the output.
***[σCC**	Do not have complex onsets (Kager 1999:97).
***CC]σ**	Do not have complex codas (Kager 1999:97).
***CodaObs**	An obstruent in a coda position is unlicensed (Piggot 2003).
Dep	Output segments must have input correspondents.
Faith	Input and output must be congruent.
Ident[Voice]	The specification for the feature [voice] of an input segment must be preserved in its output correspondent (Kager 1999:14).
Ident[Voice,Ons]	Output segments in onset position preserve values of [voice] for input correspondents (Kager 1999:340).
Max	Input segments must have output correspondents.
Max(Salient)	Perceptually salient input segments must have output correspondents (Yip 1993).
NoCoda	Syllables must be open.
***ObsNuc**	Do not have obstruent nuclei (Pater 1996:74).
OCP[place]	Adjacent identical place features are prohibited (Frisch, Pierrehumbert & Broe 2004).
OCP[cor]	No adjacent coronals (Pater & Coetzee 2005:90).
***[-son,+cont coda]**	Do not have continuant obstruent codas.
SSP-Ons	Complex onsets rise in sonority (Kager 1999:267).
Voiced Obstruent Prohibition (VOP)	No obstruent must be voiced (Ito & Mester 1998; Kager 1999).

Chapter One
The Bottleneck Challenge

1.1 The bottleneck in L2 acquisition

One of the most striking features of second language (L2) acquisition[1] is that few learners can achieve a competence comparable to native speakers (only 5% according to Selinker 1972). This situation can be schematically represented as (1-1).

(1-1) The bottleneck in L2 acquisition



Legend
L2: Second Language TL: Target Language

The bottleneck problem as stated in (1-1) is particularly relevant in today's globalized world where cross-cultural access (presumably through multilingual competence) is highly valued.

Depending on the one's assumptions about L2 acquisition, there are at least two camps of thought: Access or No Access to the principles and devices of Universal Grammar (UG). Proponents of the No Access camp (e.g. Bley-Vroman 1990; Schachter 1988) would probably not find the bottleneck effect in (1-1) surprising since a block to UG forecloses possibility of language learning through setting of grammatical parameters. Mainstream thought however leans towards the Access camp (e.g. Flynn 1987, 1996; Vainikka & Young-Scholten 1994; White 2003a) following empirical support. Firstly, it has been demonstrated that L2 learners do undergo parametric resetting (Conradie 2006; Kanno 1997; Yuan 2001). Secondly, large scale surveys reveal successful L2 acquisition to levels of

[1] The term "second language" here refers to any language that is not the first language of a speaker. In a narrower sense, nonetheless, "second language" can contrast with another term "foreign language" in terms of the roles or functions of a language. Because "second language acquisition" has become a conventional use and a well-known discipline in linguistics, "second language" in this thesis includes both the second language and the foreign language in the narrow sense for the convenience of reading. Whenever needed, the distinction between second language and foreign language will be indicated.

native competence (Hakuta, Bialystok & Wiley 2003; White & Genesee 1996). On these grounds, this research adopts the basic assumption of the Full Access school of thought.

The Full Access school of thought however includes at least two interpretations of the initial state depicted in (1-1): (i) first language (L1) competence or (ii) default UG parameters. L1 competence as the initial state is supported by the proponents of the Full Transfer hypothesis (Schwartz & Sprouse 1994, 1996). Under this interpretation, L2 acquisition is viewed as an approximation from the L1 towards the target language (TL). In contrast, proponents of No Transfer hypothesis (Platzack 1996; Epstein, Flynn & Martohardjono 1996, 1998) believe that L2 acquisition, like L1 acquisition, begins with the default parametric settings in UG. For both interpretations, the bottleneck problem is a challenge because under the Full Access conception, it is unclear what obstacles could impede L2 learners' progress to native-like proficiency. Unraveling this mystery is the central focus of this dissertation.

(1-2) Thesis Question

Why does the progress of L2 acquisition appear to stagnate at some point rather than proceeding towards native-like competence?[2]

The robustness of the bottleneck effect makes it relevant to any adequate theory of L2 acquisition. On a more generative front, linguists approach the issue from studies of the internal structures of languages and how differences between the L1 and the TL contribute to the stagnation. Sociolinguists ground the bottlenecks to attitudinal or affective factors. These different approaches are really not competing alternatives, but are complementary. This dissertation synthesizes the insights from these different approaches through addressing the interaction between I-grammar and E-grammar (Chomsky 1986:23) as well as the social environment within which the L2 learner operates. How this is done will become

[2] The use of the words "stagnate" and "native-like" should not be interpreted as implying that the intermediate states of L2 are bad, with the growing awareness that the so-called "non-native" varieties of English are not inferior and can even be employed as the local norms of language teaching (Kirkpatrick 2007:189ff). These words are used here for those learners who set their target as native varieties such as BBC English. When these learners stay at an intermediate state, it is certainly stagnation as opposed to the target they assume, and they apparently do not reach a native-like competence of the declared target.

clear in §1.4 where the basic tenets of E-Tether Theory are presented.

1.2 Generative linguistics and second language

Since L2 acquisition involves the learning of grammar, presumably through access to UG principles and devices (following Full Access, §1.1), resolving the bottleneck challenge could draw strength from the fruits of generative studies. One important aspect of generative linguistics is the recognition of the I-grammar (Chomsky 1986:23). The I-grammar is an individual's internalized knowledge of a language. Statements about the I-grammar are therefore statements of the theory of mind. In this sense, the generative enterprise is an inquiry into the human mind/brain with respect to the language faculty.

With a focus on the mental aspect of language, generative theories offer a way to understand how knowledge of language is represented in the mind of L2 speakers. This can either be universal principles and parameters (Chomsky 1981, 1986), SPE rules (Chomsky & Halle 1968), or universal constraints (Prince & Smolensky 1993/2004). These theories allow one to capture the variation between L2 systems on the one hand and the commonness of these systems on the other. As is indicated by White (2003b:20), while the generative theories differ as to how universals are formalized, they all recognize the innateness of acquisition – certain properties of language are too abstract to be acquired in the absence of innate linguistic constraints on grammars.

Another strength of the generative approach is its ability to model the development of L2 competence. In most generative theories, when learners receive the TL input that their current L2 grammars fail to accommodate to, the restructuring of the current grammars is needed. This can take the form of the resetting of parameters, the reordering of rules, or the re-ranking of universal constraints, depending on the framework one chooses. Through such transition of mental states, one can glimpse how I-grammars evolve in the course of L2 acquisition.

The virtue of the generative approach also lies in its capability to explain certain bottleneck phenomena. To this end, several proposals have been raised, including L1 transfer, markedness, and linguistic input (see Chapter Two for detailed discussion). Among these proposals, L1 transfer concerns more with the cross-linguistic differences between the L1 and the TL. The other line, typically under the name of markedness, is more related to the universal aspects of languages, suggesting that certain TL structures are difficult to acquire regardless of learners' L1. A third line attributes the bottlenecks to the input learners are exposed to. It argues that the quality and the quantity of input can determine grammar learning. Despite the different emphases, the above proposals are common in that the non-progression of L2 I-grammar could result from linguistic-internal factors.

Though a powerful tool to describe L2 acquisition, the generative approach does not adequately consider the impact of affective factors (e.g. the attitudes toward the TL, the identifications with the L1 and the TL group) on acquisition. Even living in the same social environment and being exposed to comparable TL input, individuals with different levels of motivation or holding different attitudes to the TL are likely to exhibit distinct rates of learning. This seems beyond the explanatory scope of the typical generative approach.

1.3 Affective factors and second language

Affective factors are important in L2 acquisition because, as Beebe (1985:404) points out, language learners are not passive receivers of linguistic input; instead, learners can actively construct their grammars based on their attitudes and values. For researchers interested in affective factors, the "language" in question is the language of a community. This, in Chomsky's (1986) terms, is E-language (externalized language), i.e. the collection of utterances or linguistic forms used by a population, independent of individuals' minds/brains. The collection of descriptive statements about an E-language is the grammar of that language, hence E-grammar (Chomsky 1986:20). Since E-languages are the forms directly observable by social members and are often associated with various social values, they exert influences on individuals' perceptions, attitudes, and motivations, which in turn affect the learning outcomes.

Among the affective factors, one that is frequently associated with L2 competence is learners' linguistic identity,[3] i.e. people's identification with their

[3] Note that any social member may simultaneously belong to more than one community and have multiple identities, e.g. gender, age, professional, religious (see Norton 2000 for detained discussion). This thesis focuses on linguistic identity because it has been proved as a prominent factor affecting L2 acquisition (e.g. Giles & Byrne 1982; Hall & Gudykunst 1987; Kelly, Sachdev, Kottsieper & Ingram 1993).

speech community, which in turn refers to the group of people who share a set of norms, rules and expectations regarding the use of language (Hudson 2000:239). To capture the effects of linguistic identity on ultimate L2 attainment, several models have been proposed, including the Acculturation Model (Schumann 1978, 1986), the Social Contextual Model (Clement 1980) and the Intergroup Model (Giles & Byrne 1982). The Social Contextual Model, for instance, advocates that L2 learners often encounter a struggle between the intention to identify with the TL-speaking group and the desire to retain the L1 culture and identity, termed as "intergrativeness" and "fear of assimilation" respectively. If learners perceive acquiring L2 to be extremely detrimental to their ethnolinguistic identity, they are unlikely to attain native-like L2 competence.

The identification with one's speech community often manifests itself as the positive attitudes towards the L2 variety spoken in one's community. In practice, such positive attitudes to the local L2 varieties have been widely observed (e.g. Bolton & Kwok 1990; Tan & Tan 2008; McKenzie 2010). In El-Dash & Busnardo's (2001) language attitude study, for instance, the L2 English speakers in Brazil prefer the Brazilian variety of English even more than the native varieties of English. Findings like this accord with Beebe & Giles's (1984) argument that L2 learners may be unwilling to adopt a standard accent, maintaining the L1 accent as an expression of solidarity.

The effects of linguistic identity and attitudes are mediated through learners' motivation. A low level of motivation can lead to the non-progression of L2 competence (see Gardner 1985 for a review). Alternatively, identity and attitudes may function through the affective filters (Krashen 1982), which prevent the language acquisition device from operating. In sum, the effects of the affective factors discussed in this section can be presented as (1-3).

(1-3) Affective factors of L2 acquisition

Linguistic identity → Attitudes → Motivation/ Affective filter → Leaning outcomes

This line of research unveils the role played by the affective factors associated with E-languages. Nonetheless, it overlooks how E-languages act upon the operation of individuals' internalized language systems (i.e. I-languages). If one accepts the fact that acquisition is essentially a process where learners construct the knowledge of language in their minds/brains, the exclusion of I-languages is inadequate.

1.4 The E-Tether Theory

The cognitive and the affective factors introduced in the last two sections each capture a different but equally important aspect of the bottleneck problem. Though the cognitive factors relates more to I-languages and the affective factors to E-languages, ignoring one or the other will not provide a full explanation of L2 acquisition (Beebe & Giles 1984). After all, the mental process of L2 acquisition takes place in social context. Since E-language items are the linguistic inputs for a learner to construct I-grammar, the development of I-grammar inevitably undergoes the influence of the E-language spoken in the society. Thus, a comprehensive theory of L2 acquisition should take both sides (I-language and E-language) into consideration.

To this end, I propose the E-Tether Theory (ETT), a model capturing L2 development with generative theories while taking into account the social aspect of language learning, stated as (1-4).

(1-4) **The E-Tether Theory (ETT)**

The development of the L2 mental grammar is tethered to the common L2 patterns in the speaker's community.

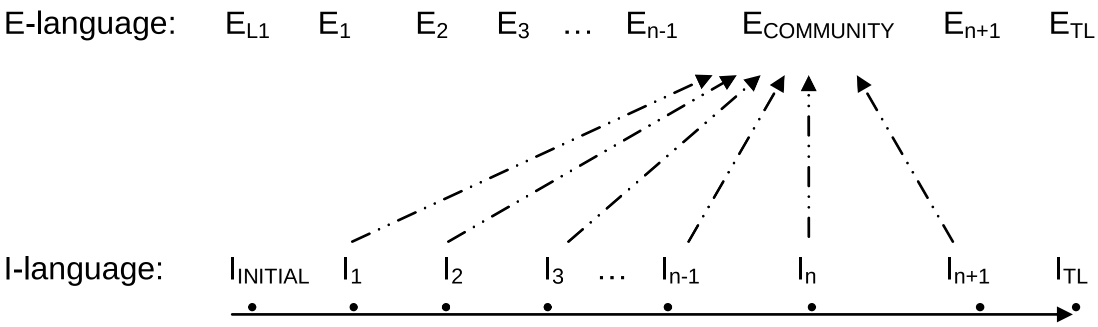
The term "tether" is a metaphor. According to (1-4), given a target language and a group of L2 speakers, the individual speakers' L2 will converge to the E-language spoken in that group. At the heart of the theory is the connection between I-language and E-language. On the one hand, E-language *per se* is made up of the common properties of various I-languages. On the other, E-language exerts influence on I-languages as it provides norms and ensures intelligibility.

The ETT bridges the generative approach and the affective factors because of its two premises. Firstly, it presupposes that L2 grammar development is a set of cognitive states, made out of the same substance provided by UG. The differences between these states lie only in the arrangement of the universal substance. For this, the ETT is neutral to all generative theories that capture the innateness of language acquisition.

Secondly, the ETT recognizes the impacts of affective factors (e.g. group identification, motivation) on L2 acquisition. It also factors the role of attitudes in speakers' choice of L2 variety. These factors make the tether of the local E-language psychologically possible.

By situating individual I-languages into the greater context of the surrounding E-language, the ETT not only explains the bottlenecks from a new perspective but also gives a holistic view of L2 acquisition. With its claim and premises settled, the architecture of the ETT is schematized as (1-5).

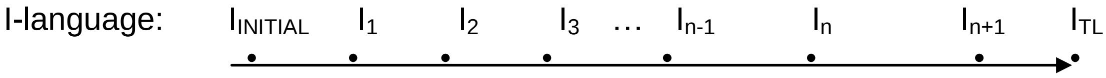
(1-5) Schematic representation of the ETT



In (1-5), the model is comprised of two dimensions: the dimension of I-language and the dimension of E-language. The two dimensions are linked by the E-tether (shown as the arrows in (1-5)) which draws individual I-languages to the E-language of their community (the $E_{COMMUNITY}$ in (1-5)). Each of the components in the ETT is explained in the following subsections.

1.4.1 The dimension of I-language

(1-6) The dimension of I-language[4]



[4] $I_{INITIAL}$ denotes the initial state of L2 acquisition; I_{TL} is the I-grammar state of the TL speakers; I_n can refer to any intermediate state of L2.

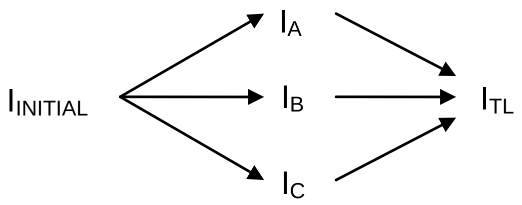
The dimension of I-language has to do with the development of L2 mental grammars (I-grammars). It encompasses two modules. One is the I-grammar states of individual speakers; the other is the force that drives grammatical development, signified by the arrow in (1-6).

The states of L2 I-grammar are denoted by the “I"s in (1-6), following the insight that “transitional competence of the learner takes the form of internalized language (I-language)” (Yip & Mathews 1995:18), termed as “I-interlanguage” by Yip & Mathews. These I-grammar states are expressible by any generative theory that captures the mental representation of language (see Yip & Mathews 1995 for example showing how the intermediate I-grammar states in syntactic acquisition are expressed through principles and parameters; Broselow, Chen & Wang 1998 for how phonological acquisition is represented by universal constraints). The series of the I-grammar states in (1-6) represent different degrees of L2 competence. To take a theoretically neutral position, the ETT assumes the initial state of L2 acquisition (the $I_{INITIAL}$ in (1-6)) as either the L1 setting (the Full Transfer/Full Access hypothesis), the default UG setting (the No Transfer/Full Access hypothesis), or a mixture of the both. Starting from this initial state, L2 competence gradually grows until the learner reaches the I_{TL} where the TL is fully acquired.

The force that drives the development towards the I_{TL} is the inconsistency between the learner’s current grammar and the linguistic input from the TL. Whenever the linguistic forms generated by the current I-grammar mismatches the TL forms, the learner will adjust the I-grammar so as to make the TL forms surfaces in the newly structured grammar, following the learning mechanism adopted in a number of generative theories (e.g. Tesar & Smolensky 2000; White 2003a).

Also note that the actual developmental route of L2 I-grammars is not necessarily a linear sequence as is depicted in (1-6). There can be more than one route for the L2 learners from the same L1 to achieve the TL competence, described as (1-7) on the next page. Since whether the or not there are multiple routes is not a crucial issue to the ETT, the linear sequence in (1-6) is employed for the ease of display.

(1-7) Multiple learning routes for L2 I-grammar development



1.4.2 The dimension of E-language

(1-8) The dimension of E-language

E-language: E_{L1} E_1 E_2 E_3 … E_{n-1} $E_{COMMUNITY}$ E_{n+1} E_{TL}

The dimension of E-language has to do with the E-grammars of a given L2. The E-grammars are externalized, existing independently of individuals' minds/brains. They show how the collection of linguistic forms (i.e. the E-language) in a community is organized. What the dimension of E-languages concerns is thus the whole society instead of individual speakers. Though Chomsky (1986:25) contends that E-language is not the focus of generative linguistics and it is "an epiphenomenon at best", E-grammar is in principle expressible by generative theories. This is because E-language is the collection of numerous I-languages which themselves are UG-based. E-language therefore also contains the components of UG and is within the variation limit of UG. Instances of how E-grammars are formalized by Optimality Theory will be provided in §5.2 and §6.2 (see Yip & Mathews 1995 for another example showing how E-language phenomena are formulated in I-language terms under the principles and parameters framework).

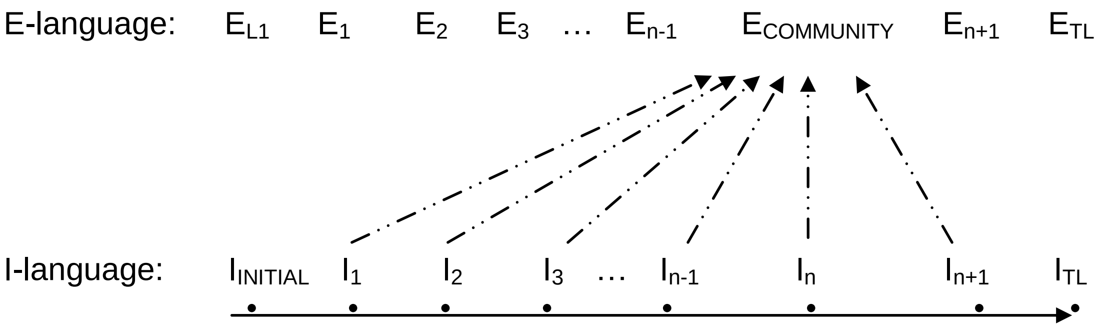
Each "E" in (1-8) denotes the E-grammar of a community for a given language. Doubtlessly, a language can vary across different communities. Variability of this kind is manifested in (1-8) through the discrete hypothetical points "E_1, E_2 … E_{n+1}". Take English as example, these points can be Hong Kong English, Indian English and Malaysian English, etc. The E_{L1} is the grammar setting of the learners' L1, with zero element of the TL.[5] The E_{TL} reflects the

[5] Since E_1/E_2/E_n etc represents different varieties of an L2, the learners' L1 can have multiple varieties as well, not just a single E_{L1}. A single E_{L1} is shown in (1-8) because this is for a particular group of learners. The E_{L1} is the L1 E-language of these learners' community, and the other

E-language patterns of the native groups of the TL. The intermediate points represent different degrees of similarity with the E_{TL}.[6] $E_{COMMUNITY}$ is the grammar of the E-language prevalent in the L2 speakers' own speech community. This E-language is important to the L2 learners because it is widely heard and spoken in the learning environment and supplies input for the learners, regardless of whether it has well-recognized grammar and lexicon. Thus it is not necessarily a recognizable variety. It does not have to be stabilized either, given that language change do occur at various rates, glacially in some instances and more discernibly in others, to any speech community. How $E_{COMMUNITY}$ affects L2 acquisition will become clear in the ensuing section.

1.4.3 The E-tether

(1-9) The E-tether



The dimension of I-language and the dimension of E-language are connected through the E-tether, illustrated in (1-9) as the arrows that link various I-grammars to $E_{COMMUNITY}$. $E_{COMMUNITY}$ is the source of the tether, driving the I-grammars in that community towards it. Consequently, individuals will converge to the common L2 patterns of their community. When the $E_{COMMUNITY}$ in an L2-speaking group is not aligned with the E_{TL}, the E-tether will prevent the I-grammars from

irrelevant L1 varieties are thus not shown. Similarly, there is a single E_{TL} in (1-8), though different communities may have different target languages, e.g. the TL for Indians would be British English and for Philippines would be American English. A single E_{TL} is presented here because it is to describe the learning situation of a particular group of learners. For example, the E_{TL} would be British English if the learners in question are Indians, and it would be American English if the learners are Philippines.

[6] Strictly speaking, the intermediate E-grammar states are not necessarily arrayed linearly as (1-8), but in parallel positions, the same way as the I-grammars shown in (1-7). A linear representation is used here for the ease of display. Technically, the intermediate E-grammars indeed can have different distances with the TL and be sequenced in a line according to the distances. A way to calculate such distances in Optimality Theory, for example, is presented in Appendix 1.

progressing towards the TL. This would result in the “fossilized” phenomenon in L2 acquisition (Selinker 1972).

The tethering effect described above can stem from the speakers’ identification with their speech community (see §2.6 for further elaboration). This point is clearly stated in Beebe (1988:63) that L2 learners may “never attain native-like proficiency to the best of their ability because they may find that the reward of being fluent in the TL is not worth the cost in lost identification and solidarity with their own L1 group”. The E-tether can also be due to the linguistic input provided by $E_{COMMUNITY}$, since $E_{COMMUNITY}$ constitutes a big proportion of the input exposed to the learners. Given that the quality and the quantity of input largely determine the outcomes of acquisition (Wexler & Culicover 1980; Krashen 1982; Boersma & Hayes 2001. See §2.5), $E_{COMMUNITY}$ inevitably plays a role in L2 acquisition.

It should be noted that the tether is from the speech community of a learner, defined in terms of social network and social relationships, not just locale. This is important because it explains the bottlenecks not only in places where the TL is not the L1 but also in TL-speaking areas. A case in point is the immigrant communities in TL-speaking countries, such as the Mexican immigrants in the United States who learn English. When the forms of the L2 spoken in these communities are not identical to the forms in the target language, the tether from the speakers’ social network will still prevent the approximation towards the target language.

1.5 The present study

Because of the E-tether, the L2 learners in a non-native community are predicted to be attracted by the L2 E-language of their community (i.e. $E_{COMMUNITY}$). To test this prediction, one needs a speech group whose L2 E-language ($E_{COMMUNITY}$) is distinct from the patterns of the TL, and then examine whether the members in this community attitudinally incline towards $E_{COMMUNITY}$ as opposed to other varieties of the L2 or the TL variety. The tethering effect is tested in this dissertation through the acquisition of English consonant clusters by the native Cantonese speakers in Hong Kong and Guangzhou

Consonant clusters are not licensed in Cantonese syllables, whereas English allows consonant clusters in syllable onset and coda (see §2.3 for an introduction to the syllable structures in English and Cantonese). To learn English, Cantonese speakers need to acquire consonant clusters which are new to them. It is however observed in the previous studies that Cantonese speakers tend to modify English consonant clusters through strategies such as consonant deletion or obstruent devoicing (e.g. Hung 2000; Peng & Ann 2004; Yam 2005; Chan 2007, 2010; Chiu 2008; Setter, Wong & Chan 2010). In other words, the English E-grammar in Hong Kong and that in Guangzhou stay at an intermediate stage which is distinct from the standard varieties of English as to consonant clusters. This makes a test to the tethering effect possible, because, by investigating the Hong Kong people and the Guangzhou people's attitudes towards the E-grammar of their respective communities, one would see whether the L2 speakers are really attracted by their E-grammar.

For two further reasons Hong Kong and Guangzhou are chosen for study. Firstly, Hong Kong and Guangzhou have different language environments in that Cantonese, English and Mandarin serve different social functions in the two cities. The experiments conducted in the two cities thus form two independent tests to the ETT. In Hong Kong, Cantonese is the most widely-used language. It is the L1 for the majority of the people and the major means of communication within the Chinese group who constitute the overwhelming majority of the population. Due to the colonial history, English is another official language. It is the language used in government and courts, and the medium of instructions in many schools. For many Hong Kong people, English meets the requirement of a true second language (Richards & Schmidt 2002:472) because it "fulfils many important functions (including the business of education and government)" and "learning English is necessary to be successful within that context". Mandarin also plays a role in Hong Kong. Since the Handover in 1997, it has been introduced into the school curriculum, hence more and more people are becoming trilingual (Setter et al. 2010). Mandarin, however, is largely a foreign language to the Hong Kong people, as its domains of use are still limited and most people learn it in classrooms. In Guangzhou, Cantonese is the mother tongue to most of the local people. For these people, Cantonese is the language used at home and in informal situations. In formal contexts, however, the most dominant language is Mandarin, due to the nationwide promotion of Mandarin in China. Given the important functions of Mandarin in government and education, Mandarin can be seen as the second language of the local people. In comparison, English is a foreign language to most of the people in Guangzhou as it is mainly used in language classrooms and for the purpose of international communication.

Secondly, despite the above differences in language environment, especially the role of Mandarin in Guangzhou, the two cities are still comparable cases for the following reasons. First of all, it has been ascertained that the L1 of the Hong Kong and the Guangzhou subjects in this study is Cantonese. Additionally, the Hong Kong subjects in fact can also the speak Mandarin, presumably due to the Mandarin courses available in the school and university curriculums. Last but not least, consonant clusters are not allowed in Mandarin either. As the inventory of syllable structures in Mandarin is even narrower than in Cantonese, Guangzhou speakers' knowledge of Mandarin will not help them to master extra syllable structures. The two groups thus have the same set of already-known structures and therefore have comparability (see §4.2 for details about the subjects).

To precisely describe the E-grammar in Hong Kong and that in Guangzhou, the pronunciations of English consonant clusters by 10 typical local speakers in each city will be analyzed. Based on the aggregation of the individual pronunciations, the E-grammar in each city (i.e. $E_{COMMUNITY}$) will be generalized and formulated. To examine whether the observed $E_{COMMUNITY}$ in each city is identified with by the English speakers in the respective cities, 129 Hong Kong subjects and 66 Guangzhou subjects will be surveyed in terms of their attitudes to the pronunciation patterns in $E_{COMMUNITY}$ and to other possible ways to produce English consonant clusters. One then would be able to identify the grammar that is attitudinally preferred by the subjects in each city, and ultimately determine whether there is an alignment between the preferred grammar and $E_{COMMUNITY}$. Details about the experiment will be given in Chapter Four; the results in each city will be presented in Chapter Five and Six.

1.6 Summary

To account for the stabilization of L2 competence (the "bottleneck"), this chapter advocates the E-tether Theory (ETT) of L2 acquisition. The ETT unravels how social environment impacts upon the development of L2 I-grammars through E-language. In the ETT, the acquisition processes can be summarized as (1-10).

(1-10) Acquisition under the ETT

- Given a community where two languages are spoken, there is an E-language for the L2, shared by the members of the community.
- Individuals in the community are tethered to that E-language. The tether may restrain the development of L2 competence which itself is powered by the linguistic input from the TL.

The ETT represents an incorporation of the cognitive and the social aspects of L2 acquisition. This is because it recognizes the central role of I-grammars on the one hand and considers the impacts of social environment and linguistic identity on the other. The cognitive aspect and the social aspect are linked in the ETT through the E-tether, a centrifugal force that draws L2 speakers' I-grammars towards the E-grammar of the local community (i.e. $E_{COMMUNITY}$). The E-tether stems both from individuals' identification with their speech community and from the linguistic input provided by $E_{COMMUNITY}$. When $E_{COMMUNITY}$ is not identical to the grammar of the TL, the tethering effect of $E_{COMMUNITY}$ will prevent the progression of L2 towards the TL. This non-progression is the crux of the bottleneck problem.

The ETT also advances the understanding of L2 acquisition. Firstly, it clearly indicates the role performed by the non-native variety used in a learner's speech community (i.e. the $E_{COMMINITY}$ in the ETT). In L2 acquisition studies, the bottleneck problem is often attributed to a learner's L1 or markedness; other researchers may resort to society for explanations, looking at the relative dominance of the L1 and the TL or the socio-economic status of the relevant speech groups (see Ellis 2008 for a thorough discussion). There is little emphasis on the L2 variety spoken in a learner's community which nonetheless supplies a large proportion of input. The ETT thus offers a new perspective to approach the bottleneck problem. Secondly, the ETT can predict at which developmental stage the bottleneck problem may occur. That is, a learner's L2 competence may eventually stabilize at a stage comparable to the grammatical patterns of his/her community. This allows one to better capture the developmental path of L2 acquisition.

Centering on the theme of the ETT, the remaining chapters are organized as follows. Chapter Two lays the theoretical ground of the ETT. It shows why the dimensions of I-language and of E-language should be taken into consideration and demonstrates the plausibility of the E-tether.

Though theoretically viable, the validity of the ETT still awaits empirical verifications, which can typically be done through experimentation. To make the experiment results comprehensible, Chapter Three shows how the ETT can be understood under the framework of Optimality Theory. On this ground, Chapter Four presents a detailed elaboration of the experiment introduced in §1.5 which tests the ETT through the acquisition of English consonant clusters by the native Cantonese speakers in Hong Kong and in Guangzhou. Specifically, the experiment probes into whether the English speakers in each city attitudinally incline towards the L2 E-grammar of their own community, a scenario predicted by the E-tether.

Based on the experiment results, Chapter Five discusses the applicability of the ETT to the English speakers in Hong Kong. In a similar manner, Chapter Six demonstrates how well the ETT fits to the English speakers in Guangzhou. The findings in both cities suggest that the L2 speakers do identify with the L2 E-language of their respective communities, which is consistent with the prediction of the ETT.

In Chapter Seven, I will show how the ETT can be incorporated with the insights from other L2 acquisition theories to give a more comprehensive account for the bottleneck. This is followed by a conclusion.

Chapter Two

I-language and E-language in Second Language Acquisition

This chapter establishes the theoretical foundations of the E-tether Theory (ETT). It shows the necessity to include both the dimension of I-language and the dimension of E-language. The dimension of I-language is important because any comprehensive treatment of L2 acquisition must take into account (i) the innate linguistic abilities (typically called Universal Grammar) and (ii) the already acquired L1 grammar. While the bottleneck problem has cognitive causes, the approach that looks merely at I-language fails for two reasons. Firstly, it does not explain why L2 development varies in different social environments (Tarone 1994; Siegel 2003; Ellis 2008). Secondly, the dimension of I-language fails to explain why the degree of success of L2 acquisition positively correlates with the how strongly the learner identifies with either the community wielding the target language or any of the “interlanguage” stages/varieties (Gardner & Lambert 1972; Schumann 1986). This calls for the involvement of the dimension of E-language, which represents environment where L2 acquisition takes place.

§2.1 outlines basic aspects of I-language relevant to the ETT. §2.2 and §2.3 discuss how the L1 grammar and the tendencies in Universal Grammar contribute to the bottleneck when I-language is recognized as the object of study. §2.4 addresses the inadequacies of the dimension of I-language and indicates the necessity to include the dimension of E-language. §2.5 demonstrates how E-language affects L2 acquisition through linguistic input. §2.6 shows the relation between E-language and learners’ linguistic identity, which can eventually leads to the bottleneck in L2 acquisition. §2.7 gives a summary.

2.1 I-language and second language acquisition

Like L1 acquisition, L2 acquisition is characterized by what Chomsky (1965:58, 1986:7) called “poverty of stimulus”. That is, L2 learners exhibit linguistic behaviors not reducible to the set of stimuli from the L1 or the L2 input (e.g. Dekydtspotter, Sprous & Anderson 1997, Kanno 1997, and Perez-Leroux & Glass 1999, among others. See White 2003a for a comprehensive review). An example is the complex question formation in the English of native Japanese speakers (Otsu & Naoi 1986, cited in Ko 2005). Subject-auxiliary inversion does not apply in the question formation in Japanese, and the L2 learners are taught only the subject-auxiliary inversion of the English simple questions, shown as (2-1).

(2-1) Simple question taught to the English learners in Japan

a. The girl **is** in the room.

→ b. **Is** the girl __ in the room?

Crucially, these L2 learners are not exposed to the subject-auxiliary inversion of English complex questions. Nonetheless, they can still correctly apply inversion to complex questions, producing forms such as (2-2-b) but not (2-2-c).

(2-2) Complex question formation by the English learners in Japan

a. The girl who **is** in the room **is** laughing.

→ b. **Is** the girl who **is** in the room __laughing?

c. ***Is** the girl who __ in the room **is** laughing?

Evidence of this kind suggests that L2 acquisition is also guided by Universal Grammar (UG) (Chomsky 1965: 112), the innate knowledge that allows humans to successfully develop complex linguistic systems despite the limitation of input. Based on the innate knowledge, individuals set up the unconscious, internalized system of language (i.e. the I-language) through interaction with presented experience. An adequate model of L2 acquisition must therefore include the dimension of I-language, echoing Yip & Mathews's (1995:18) insight that "interlanguage should be analyzed in I-language terms, with the focus on the learner's competence".

2.2 L1 transfer and the bottleneck

With I-language as the object of study, the bottleneck in L2 acquisition is usually associated with the learner's existing L1 knowledge. The strongest claim for this position is made in the Contrastive Analysis Hypothesis (CAH) (Lado 1957) which predicts that any element of the target language (TL) which is different from the L1 will cause learning difficulties. Though Wardhaugh (1970) refines Lado's idea and proposes a weaker version of CAH, it sill uses the learner's L1 to explain at least some of the L2 errors.

The role of L1 is also explicitly stated in some other theories. For example, the Full Transfer Full Access Hypothesis (Schwartz & Sprouse 1994, 1996) argues that the entire L1 grammar forms the initial state of L2. Whenever the L1 grammar and the TL input are inconsistent, restructuring away from the L1 will take place. In the Interlanguage Hypothesis (Selinker 1972), L1 transfer is listed as one of the five central psychological processes in L2 acquisition. Selinker further claims that L2 learners tend to make “interlingual identifications”. That is, they perceive certain linguistic items as the same in the L1 and in the TL, and use the L1 usage to infer the TL usage.

In practice, cases showing L1 transfer can be found in nearly all aspects of L2 acquisition. An instance in syntax is from White (1991; cited in Lightbown & Spada 2006), which investigates the acquisition of adverb placement in the L2 English of native French speakers and in the L2 French of native English speakers. In English and French, adverbs can be placed in different positions in a simple sentence. However, English allows for SAVO order which is unaccepted in French; French licenses SVAO order which is ungrammatical in English, exemplified as (2-3).

(2-3) Adverb placement in English and French (Lightbown & Spada 2006: 95)

S = Subject V = Verb O = Object A = Adverb
ASVO Often, Mary drinks tea. Souvent, Marie boit du thé.
SVOA Mary drinks tea often. Marie boit du thé souvent.
SAVO Mary often drinks tea. *Marie souvent boit du thé.
SVAO *Mary drinks often tea. Marie boit souvent du thé.
Note: “*” indicates that the sentence is not grammatical.

For the French-speaking learners of English, it is easy to add the SAVO order to their repertoire; for the English-speaking learners of French, acquiring the SVAO order is also smooth. Nevertheless, both groups encounter difficulties in getting of rid of the L1 word order which is absent in the TL. The French-speaking learners of English continue to consider the SVAO order as grammatical in English; the English-speaking learners of French accept the SAVO order in French.

In phonology, transfer effect can be found in the acquisition of English onset clusters by the native Mandarin speakers in Taiwan (Lin 2001). Lin observes a tendency for the learners to insert a schwa to English CC onsets. Word-initial /pli/, for example, is realized as [pə.li], describable by the rule below.

(2-4) $\varnothing \rightarrow$ ə / #C __ CV (“#” denotes word boundary)

According to Lin, that the learners employ vowel insertion, out of all possible ways to avoid consonant clusters, is a transfer of the L1 Mandarin. In Mandarin, CC onsets are disallowed. The preferred way to prevent onset clusters is also vowel epenthesis, reflected by the translation of English names. *Claire*, for example, is translated in Taiwan Mandarin as [kə.lai].

L1 transfer applies to phonetics as well. It is widely observed that L2 learners tend to interpret L2 segments in terms of their L1 (e.g. Beddor & Strange 1982; Gottfried & Beddor 1988; Best & Strange 1992; among others). The L2 sounds that have phonetically similar equivalents in the L1 may be perceived and produced the same way as the L1 equivalents, a phenomenon described in speech learning theories as “equivalence classification” (Flege 1995) or “native language magnet” (Iverson & Kuhl 1995). Qin (2010), for example, finds that native Vietnamese speakers perceive both the Received Pronunciation (RP) vowels [i] and [ɪ] as the same Vietnamese equivalent [i], which is acoustically similar to the RP [i] and [ɪ].

Cases supporting L1 transfer is certainly not limited to the examples above. In syntax, the transfer of the L1 parametric setting to L2 is reported also in Camacho (1999) and Yuan (2011). In phonological acquisition, researchers, through a careful examination of the L1, also find ways to explain why the same

L2 is realized differently by speakers from different L1 backgrounds. For example, by comparing Egyptian Arabic and Iraqi Arabic, Broselow (1987) accounts for why, though the English learners in Egypt and in Iraq both insert a vowel to English CC onsets, the Egyptians insert it between the two consonants whereas the Iraqis insert it to the left of the whole cluster. Similarly, by appealing to the L1, Hancin-Bhatt & Bhatt (1997) illustrates why the Spanish-speaking learners of English delete the second consonant in English CC codas while the Japanese-speaking learners of English delete the first.

Though powerful in explaining the bottleneck in L2 acquisition, L1 transfer is by no means the only source of learning difficulties. L2 learners sometimes make errors that are independent of the L1, leading towards the discussion of markedness in §2.3

2.3 Markedness and the bottleneck

In human languages, there is a tendency to prefer certain structures over others. The preferred structures, such as open syllables or oral vowels, are unmarked; the disfavored structures, such as closed syllables or nasal vowels, are marked (Eckman 2008:96; see Battistella (1990), de Lacy (2006) and Rice (2007) for further discussion on markedness). Eckman (1977, 1991) points out that markedness also plays a role in L2 acquisition. Marked structures usually pose more learning difficulties than unmarked structures do. Some examples are provided as follows, mostly on phonology.[1]

Cross-linguistically, word-final voiced obstruents are more marked than voiceless ones (Broselow, Chen & Wang 1998:267). Through the acquisition of English by native Hungarian speakers, Alternberg & Vago (1983) finds that the asymmetry between voiced and voiceless codas holds also for L2. For example, the final voiced stops in English words *end*, *band*, and *beyond* are realized by the learners as voiceless. Crucially, this cannot be a transfer effect, since Hungarian makes voicing contrast for word-final obstruents. The universal tendency to avoid final voiced obstruents is thus the cause of the devoicing. In the study of Eckman (1984), native Farsi speakers also devoice the final obstruents in English, despite the presence of voicing contrast in Farsi for final obstruents.

Another domain that is frequently linked with markedness is the acquisition

[1] This is due to the fact that the majority of L2 studies on markedness center around phonology.

of consonant clusters. According to the Resolvability Principle (Greenberg 1978:250), longer consonant clusters are more marked than shorter ones. To test whether this markedness relation applies to L2, Chan (2010) investigates the acquisition of English onset clusters by Native Cantonese speakers in Hong Kong. The results confirm that the less marked English CC onsets are acquired before the more marked CCC onsets, consistent with the Resolvability Principle. Similar findings in support of the Resolvability Principle include Carlisle (1997, 1998) on the acquisition of English onsets clusters by native Spanish speakers, and Anderson (1987) on the acquisition of English consonant clusters by native speakers of Egyptian Arabic, Mandarin, and Amoy Chinese.

The markedness of consonant clusters depends not only on the length of clusters, but also on the consonants that compose the clusters. Stop-stop codas (e.g. [kt], [pt]), for example, are universally more marked than fricative-stop codas (e.g. [st], [sk]) (Greenberg 1978:254), presumably because of sonority. Through the acquisition of English coda clusters by the learners whose L1 is Cantonese, Japanese or Korean, Eckman (1991) shows that the L2 learners do encounter more difficulties with stop-stop codas than with fricative-stop codas, though both types of clusters are absent in the L1. Similarly, Benson (1986) also observes the better performance of native Vietnamese for English fricative-stop codas than for stop-stop codas.

Markedness also affects L2 syntax. A case in point is Eckman, Bell & Nelson (1988) who investigate the acquisition of English relative clauses by the learners from different L1 backgrounds. According to the Accessibility Hierarchy (Keenan & Comrie 1977), the relative clauses where the relative pronoun functions as the subject (exemplified as (2-5-a)) are less marked than those where the relative pronoun functions as the object of a preposition (shown as (2-5-b)).

(2-5) a. Joan likes the professor *who* gives easy exam to the class.
b. The chairman listened to the student to *whom* the professor gave a low grade.

Based on experiment results, Eckman et al. find that the marked structure in (2-5-b) indeed poses more difficulties to the L2 learners than the structure in (2-5-a) does – the learners who have acquired (2-5-a) do not necessarily master

(2-5-b); the learners who have acquired (2-5-b) also have acquired (2-5-a).

The evidence provided thus far shows the correlation between markedness and L2 learning difficulties. The marked structures in the TL, together with L1 transfer, constitute the linguistic internal reasons for the bottleneck.

2.4 Inadequacies of the I-language-only approach

Though powerful in unraveling the effects of L1 transfer and markedness on acquisition, an approach that focuses only on I-language still has its inadequacies.

Firstly, it does not explain the impacts of external environment, especially the environment which supplies linguistic input to L2 learners. Given the universal Language Acquisition Device and the same L1 background, the stages at which L2 development ceases may vary in different social contexts (Gass 1987; Dussias & Sagarra 2007). The best reflection of this is perhaps language immersion programs, which requires the learners from another language background (typically international students or immigrants) to be fully involved in the school and the social life of the TL community. Though variation exists, the boost that immersion brings to L2 competence is not rare to see (e.g. Fathman 1978; Gass 1987; Dussias & Sagarra 2007).

Secondly, an I-language-only approach fails to account for why L2 achievement often varies according to how strongly a learner identifies with the TL community or with the local community (cf. §1.3). As Gardner & Lambert (1972) points out, a native-like attainment would be difficult to achieve if the learner resists adapting to the language and the culture of the TL community. Similarly, Giles & Byrne (1982) states that a strong identification with the local community will prevent the full mastery of the TL.

Given the inadequacies of the dimension of I-language, a comprehensive understanding of L2 acquisition needs to take into account the dimension of E-language, which deals with the language used and shared by a community. An insight on E-language would help us better understand how social environment impacts upon individual I-grammars. Such effects of E-language will become clear in the following two sections.

2.5 E-language as the source of linguistic input

In generative linguistics, the restructuring of I-grammars towards the TL depends on linguistic input, which is an aspect that links I-language with the external environment (i.e. the E-language). E-language is important in this process because it provides linguistic input for grammar learning. Partly through linguistic input the E-tether is established (see §2.6 for another line of argument for the E-tether). The influence of input can be seen in two aspects: the *quality* and the *quantity* of input.

The quality of input is important because only appropriate input can trigger the changes of L2 I-grammars. As White (2003a:157) pointes out, while UG provides L2 learners with the principles, parameters, or constraints necessary for L2 acquisition, input plays a crucial role in determining how the parameters or constraints should be set or arranged. White (2003a:158-163) illustrates this through the acquisition of English by native speakers of French. In French, the Verb Raising Parameter is “on”, so that finite verb is raised to the position of Inflection and appears before negative or adverb, exemplified below.

(2-6) a. The example where verb appears to the left of negative

Les chats attrapent pas les chiens.

[$_{IP}$ Les	chats	attrapent$_i$	[pas	[$_{VP}$ t_i	les	chiens]]
the	cats	catch	not		the	dogs

“Cats do not catch dogs.”

b. The example where verb occurs to the left of adverb

Les chats attrapent souvent les souris.

[$_{IP}$ Les	chats	attrapent$_i$	[souvent	[$_{VP}$ t_i	les	souris]]
the	cats	catch	often		the	mice

“Cats often catch mice.”

Note: “IP”: Inflection phrase; “VP”: Verb phrase; “i”: Inflection; “*t*”: Trace.

When native French acquire English, they have to switch from the “on” setting in French to the “off” setting in English, since in English verb is part of verb phrase (VP) and occurs to the right of negative or adverb. Such resetting, however, cannot be secured if the learners only receive input like (2-7).

(2-7) Cats catch mice.

(2-7) is ambiguous because the main verb *catch* can either be part of Inflection (shown as (2-8-a)) or part of VP (shown as (2-8-b)).

(2-8) a. [$_{IP}$ Cats catch$_i$ [$_{VP}$ t_i mice]]
b. [$_{IP}$ Cats [$_{VP}$ catch mice]]

There hence should be clear instances showing that the main verb occurs after negative or adverb, such as (2-9).

(2-9) a. Cats **do not** catch dogs.
b. Cats **often** catch mice.

L2 phonological acquisition also has requirement on linguistic input. The basic idea is that there should be evidence informing the learners about the inconsistency between the TL and their current I-grammars (Tesar & Smolensky 1998, 2000; see §4.2 for the error-driven learning in Optimality Theory). Take the acquisition of English consonant clusters by native Mandarin speakers as example. Since Mandarin does not have consonant clusters, the primary learning data should be the English instances carrying consonant clusters. We cannot, however, guarantee the quality of linguistic input for the learners in non-native contexts, since most of their teachers and classmates are non-native speakers. Given that English consonant clusters are often simplified by Mandarin speakers (cf. Lin 2001, §2.2), whether the needed input is available would be in doubt.

Traditionally, generative linguistics puts more emphasis on the quality of input. In some cases, one instance would suffice parameter resetting (Gass 1997:89). Recent studies suggest that the quantity of input also plays a role. In the Graduate Learning Algorithm (Boersma 1997, 1998, 2000; Boersma & Hayes 2001), the grammar of language learners is a reflection of the distribution frequency of the input data. A similar claim is made in the Maximum Entropy Grammar (Goldwater & Johnson 2003; Jager 2004; Hayes & Wilson 2008), though a different evaluation mechanism is employed. Turning to Mandarin speakers' acquisition of English consonant clusters discussed above, it is not the absolute occurrence but the amount of learning data that matters. Even if the learners observe accurate examples of consonant clusters, the overwhelming amount of simplification instances in the local E-language can still prevent the learners from fully acquiring consonant clusters.

Empirically, the effect of input frequency has been attested. Broselow & Xu (2004), for examples, uses input frequency successfully predicting the acquisition order of English final obstruents by native Mandarin speakers, though they find that perceptual factors also play a role. In syntactic acquisition, Cazden, Cancino, Rosansky & Schumann (1975) and Gass & Lakshmanan (1991) observe that the frequency of subjectless utterances in L2 English corresponds to the frequency of these structures in the input.

To conclude, generative linguistics takes into account the impacts of linguistic input. If language is viewed as a purely cognitive system, learning responses should be made for every piece of input data. For the learners living in non-native communities, the E-language of their community ($E_{COMMUNITY}$) inevitably affects L2 grammar, since $E_{COMMUNITY}$ constitutes a big proportion of input. The E-tether (cf. §1.4.3) can then be understood in terms of linguistic input.

2.6 E-language and linguistic identity

The significance of E-language also lies in that it represents the observable features by which speakers categorize themselves and others into different speech communities (Mohanan 2003:8). In other words, E-language can be closely tied up with one’s linguistic identity, which in turn is driven by the desire for recognition, affiliation and security (Norton 2000:8). For L2 learners, linguistic identity is important in determining the success of learning. If a learner “is highly ethnocentric and hostile, we have seen that no progress to speak of will be made in acquiring any aspect of the language” (Gardner & Lambert 1972:134), a point that has been evidenced by numerous studies (Morgan 1993; Abu-Rabia 1997; Dewaele 2005; among others). Given the close link between E-language and linguistic identity, the identification with the one’s speech community can translate into the identification with the L2 E-language spoken by that community (i.e. $E_{COMMUNITY}$). This constitutes another source of the proposed E-tether.

The identification with $E_{COMMUNITY}$ as argued in the ETT can be reflected by L2 speakers’ positive attitudes towards the L2 variety spoken in their own community. Take the acquisition of L2 English as example.[2] The instances where the learners positively view the in-group non-native accent abound, though ambivalent feelings are also observed. Crucial to the ETT are the studies done in the Outer Circle and the Expanding Circle countries, following the notion of "Three Circles" of English (Kachru 1985:366).

In the Outer Circle context, Tan & Tan (2008) observes that Singlish, an indigenized variety of English, is valued by the pupils in Singapore. For the pupils, Singlish is not "bad" English. Instead, they consider it as part of their unique culture which makes them sound different from other people. Furthermore, Singlish serves to reduce social distance and helps people interact effectively. In a somewhat similar context, the English learners in Malaysia rate Malaysian English higher than British English and American English in terms of pleasantness and familiarity (Pilus 2013). In India, approximately 50 percent of the college-educated English users believe that the indigenous features should be the local norms for English usage and the models for English language teaching (Kachru 1976, cited in Lowenberg 1992).

Back in Hong Kong, the Hong Kong people's positive attitudes toward Hong Kong English (HKE) have been reported in Bolton & Kwok's (1990), Zhang (2010) and Sewell (2012). In Bolton & Kwok's (1990) study, most of the Hong Kong students are able to recognize the HKE accent, and some even perceive the accent as the marker of "Hong Kong Man", a positive image of the ethnic group. Differing from Bolton & Kwok (1990) where the attitudinal judgments are based on the recordings of a whole text, Sewell (2012) adopts a feature-based method, i.e. the judgments are based on individual phonological features. Sewell finds that the attitudes toward HKE can be better understood in terms of its sub-varieties. The educated HKE accent is positively evaluated by the local students and is acceptable for pedagogical purposes, an observation similar to that of Zhang (2010).

The preference toward local L2 varieties is also observed in the Expanding Circle countries. In a research on the Japanese English learners' attitudes toward different English accents, McKenzie (2010) finds that the Japanese participants exhibit a clear preference for the heavily-accented Japanese English in terms of

[2] In practice, the variety-oriented attitudes are frequently addressed through the attitudes toward native and non-native accents of English, possibly because of the global spread of English.

social attractiveness. The result implies that the learners "perceive a high degree of solidarity with the heavily-accented Japanese speech" (p.148). Similarly, it is reported in Europe that the Greek-speaking English learners evaluate the Greek accent with less L1-influence positively in terms of solidarity (Beinfoff 2013). In South America, El-Dash & Busnardo (2001) observes that the majority of the Brazilian adolescents rate the English spoken by Brazilians higher than British English and American English both in solidarity and in status.

It should be noted that while most studies suggest the positive attitudes toward local varieties in terms of solidarity, the influence of native varieties is still hard to ignore, since they commonly receive higher ratings along the traits of status. It is not to say that $E_{\text{COMMUNITY}}$ will completely replace the role of native varieties. Instead, the point here is that the positive attitudes will make it possible for the features of $E_{\text{COMMUNITY}}$ to enter the developing L2 I-languages, and hence, the actual developmental path of L2 is never as smooth as the idealized situation where there is only one input provider, i.e. the native TL varieties.

2.7 Summary

This chapter justifies the inclusion of the dimension of I-language and the dimension of E-language in the E-tether Theory. It first points out the significance to take into account the internalized linguistic knowledge (i.e. the I-language) of L2 learners, which in turn is affected by two factors: (i) L1 transfer, and (ii) the tendencies in the Universal Grammar, termed as markedness. The dimension of I-language alone, however, fails to explain the effects of external environment (E-language environment, in generative terminology) which provides learners with linguistic input. It also overlooks how linguistic identity impacts upon L2 acquisition through E-language. A comprehensive theory of L2 acquisition thus should recognize both the roles of I-language and E-language. The linguistic input from E-language and learners' linguistic identity jointly contribute to the formation of the E-tether.

Chapter Three

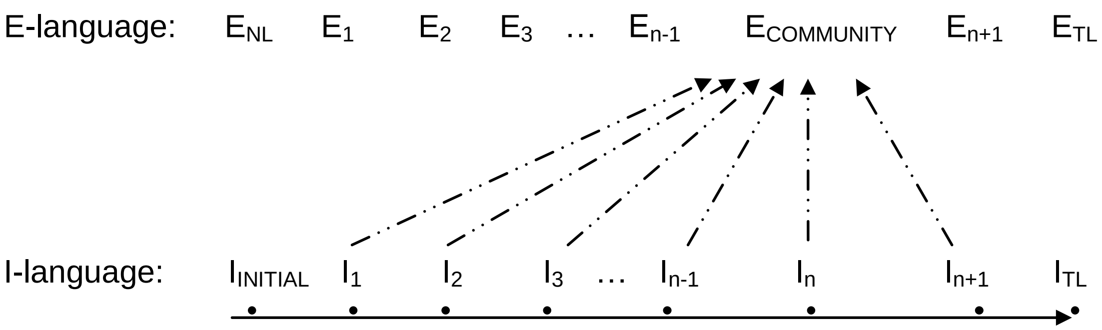
Understanding the E-tether through Optimality Theory

The stagnation of L2 competence (the “bottleneck problem”) is approached in the E-tether Theory (ETT) through the force of attraction that E-grammar imposes on individual I-grammars, i.e. the E-tether. This tethering effect is expressible in Optimality Theory (OT) (Prince & Smolensky 1993/2004) through the similarities and differences in the constraint hierarchies of relevant grammars. Moreover, the learning algorithms derived from OT give a characterization of how the E-tether affects the dynamics of L2 development. §3.1 further explicates the ETT based on the discussion presented in Chapter Two. As a framework describing the I-grammars and the E-grammars in the ETT, OT is briefly introduced in §3.2. §3.3 shows how an L2 is acquired in OT, using the Constraint Demotion Algorithm (Tesar & Smolensky 2000). Through the demotion process, the effect of the E-tether is demonstrated in §3.4. A summary is given in §3.5.

3.1 I-grammar development as tethered to E-grammar

On the ground of Chapter Two, this section provides a further explanation of the ETT, schematized as follows (cf. (1-5)).

(3-1) Schematic representation of the ETT



The ETT consists of three modules: (i) the Dimension of I-language, (ii) the Dimension of E-language, and (iii) the E-tether which links the two dimensions.

In the Dimension of I-language, the object of study is the internalized L2 knowledge of individual speakers. The I-grammars within this dimension are affected by two factors which may interfere the development of L2 competence: (i) the already acquired L1 grammar (cf. §2.2), and (ii) the general tendencies in Universal Grammar, termed as markedness (cf. §2.3).

Given the impacts of social environment in L2 acquisition, the Dimension of E-language is also included. In this dimension, the “language” being studied is the external language of a society, i.e. the totality of utterances that can be made in a speech community. It is independent of the cognitive system of individuals and is associated with L2 learners’ linguistic identity (cf. §2.6)

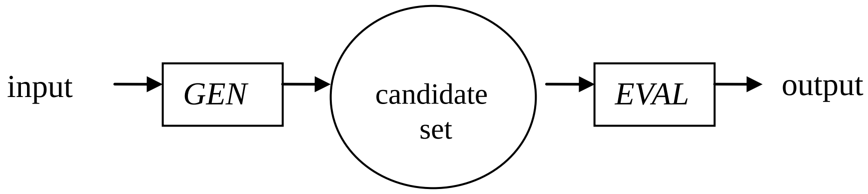
The Dimension of I-language and the Dimension of E-language are linked by the E-tether (the arrows in (3-1)), which manifests itself as individual speakers’ preference towards the L2 E-language of their community (i.e. $E_{COMMUNITY}$). This tethering effect has cognitive and affective basis. From a cognitive point of view, the E-tether can be caused by the linguistic input provided by $E_{COMMUNITY}$ (cf. §2.5). From an affective perspective, the E-tether results from learners’ identification with their speech community (cf. §2.6). Under the joint effects of the cognitive and the affective factors, L2 learners are restrained by $E_{COMMUNITY}$, thus giving rise to the bottleneck effect.

The ETT is theoretically neutral and can be stated through any generative theory that recognizes Universal Grammar (UG). Since this thesis will examine the ETT through phonological acquisition, Optimality Theory (OT) is adopted as the framework, given the effectiveness of OT in describing phonological facts. A brief introduction of OT will come in the following section.

3.2 Basics of OT

OT grammar is an input-output mechanism that assigns to each input a structural description (output) through the interaction of universal constraints, schematized as (3-2).

(3-2) Schema of OT grammar (adapted from Archangeli 1999:534)



The process in (3-2) can be described as:

(i) An input (the underlying lexical form) is submitted to the Generator (*GEN*).

(ii) *GEN* generates a set of candidate outputs for the input.

(iii) The generated candidates are submitted to the Evaluator (*EVAL*) for assessment.

(iv) *EVAL* uses a hierarchy of universal constraints to assess the harmony of the candidates. The candidate that best satisfies the highest ranked constraints will surface as the output.

OT places no restriction on input and *GEN*. *EVAL* is the central component, responsible for selecting the optimal output from the candidate set (Kager 1999:21). At the heart of *EVAL* is a set of universal constraints, which are divided into two families: markedness constraints and faithfulness constraints. Markedness constraints express pressure towards certain structures (e.g. syllables are open; vowels are oral rather than nasal). Faithfulness constraints require the properties in input and in output to be congruent. The two families are inherently conflicting so that no output can simultaneously satisfy both families.

Each language ranks the constraints in a language-specific hierarchy, with the higher-ranked constraints taking priority over the lower-ranked ones. A constraint can only be violated to satisfy a higher-ranked constraint, but the violation has to be minimal. The optimal output is the one that incurs the least serious violation, taking into account the constraint hierarchy (Kager 1999:13ff.). The selection procedure can be exemplified through the evaluation tableau in (3-3).

(3-3) Selection procedure in OT

input	C_1	C_2	C_3	C_4
Candidate A			**!	
Candidate B	*!			
☞ Candidate C			*	
Candidate D		*!		

The constraints C_1, C_2, C_3, C_4 are in descending precedence from left to right. Candidate B and Candidate D are ruled out because there are candidates that better satisfy the two highest-ranked constraints C_1 and C_2. Though both Candidate A and Candidate C violate C_3, the violation incurred by Candidate A is more serious. Candidate C is therefore selected as the optimal output.

The constraints are the innate components of UG. Cross-linguistic variation is due to the ways the constraints are ranked. Acquiring a target language (TL) thus involves two parts: (i) acquiring the underlying representations, and (ii) deducing the language-specific constraint ranking.

For the establishment of the underlying representations, Smolensky (1996a) proposes that learners will select the perceived TL forms as the underlying representations. This can be illustrated through (3-4). Suppose a learner's grammar is NoCoda >> Faith. When an output such as [tat] is heard from the TL, the learner has to assign an input to it. Like the selection of output, the selection of the optimal input is subject to the same constraint ranking.

(3-4) Selection of input

[tat]	NoCoda	Faith
☞ /tat/	*	
/ta/	*	*!

Faith: Input and output must be congruent.

NoCoda: Syllables must be open.

Since the markedness constraint NoCoda evaluates only the output and the output (i.e. [tat]) is given, it is only the faithfulness constraint at work. The optimal input is thus the one that gives the most faithful input-output mapping, i.e. /tat/.

The other part of language learning involves the adjustment of the learner's grammar, manifested as the re-ranking of constraints. To understand the re-ranking, three issues need to be addressed: (i) the triggering force of the re-ranking, (ii) the starting point of the re-ranking, and (iii) how the re-ranking proceeds towards the target.

For the first issue, the mainstream OT studies (e.g. Tesar & Smolensky 2000; Boersma & Hayes 2001) hold that the re-ranking is triggered by the learning data received by a learner, presented in the form of positive evidence, i.e. the full grammatical forms in the TL. Whenever there is a mismatch between the positive evidence and the output generated by the learner's current grammar, the re-ranking is triggered. This is the mechanism of *error-driven learning*.

For the second issue, it is generally believed that markedness constraints outrank faithfulness constraints at the initial state of L1 acquisition (Demuth 1995; Smolensky 1996a, 1996b; Davidson, Jusczyk & Smolensly 2004; Gnanadesikan 2004; Legendre 2006).[1] In L2 acquisition, the initial state can either be the L1 constraint ranking (e.g. Lombardi 2003; Hancin-Bhatt 2008; Major 2008) or the default state of UG (e.g. Platzack 1996; Epstein, Flynn & Martohardjono 1996, 1998), depending on one's standpoint on this issue (cf. §1.1).

The third issue, related to learnability, can be stated as (3-5). A solution to this issue will come in §3.3.

(3-5) Grammar learning problem (Tesar & Smolensky 2000:31)

Given:

- Learning data in the form of full grammatical structural descriptions.
- The universal components of any OT grammar (the function *GEN*, the constraints CON).
- The set of possible inputs.

Find:

- A language-particular OT grammar, consisting of a ranking (or set of rankings) of the constraints, consistent with all the given data.

3.3 Constraint Demotion Algorithm

The grammar learning problem in (3-5) can be resolved by the Constraint Demotion Algorithm (CDA) (Tesar & Smolensky 1998, 2000), which also provides a useful tool capturing the dynamics involved in L2 development. Following the error-driven manner, CDA deduces the target ranking by comparing the observed TL form (the *winner* in the target ranking) with the optimal output in the learner's current ranking (the *loser*). Grammar learning is represented as the demotion the loser-favoring constraints.

This can be illustrated through the acquisition of syllable structure. If the learner's grammar is as the constraint ranking shown in (3-6), the output for the input /C_1VC_2/ would be [C_1V].

[1] For detailed discussion on this issue, see Velleman & Vihman (2002), Fikkert & de Hoop (2009) and Qin (2014).

(3-6) The learner's current ranking

*CC, NoCoda >> Dep >> Max

***CC:** Do not have consonant clusters in the output.

Dep: Output segments must have input correspondents.

Max: Input segments must have output correspondents.

Suppose, for the same input, the learner observes from the TL a positive example [C_1VC_2]. Since the learner knows that the positive example (the winner) is more harmonic than the current output (the loser) in the unknown target ranking, the loser-favoring constraints will be demoted so as to make the TL form surfaces in the newly structured grammar.

CDA accomplishes this in two steps. The first is to identify the *constraints* violated by the winner (the *winner-marks*) and those by the loser (the *loser-marks*). Take the input /C_1VC_2/ as example, a mark data pair can be formed as (3-7).

(3-7) Mark data pair for /C_1VC_2/

loser	<	*winner*	*loser-mark*	*winner-mark*
[C_1V]	<	[C_1VC_2]	Max	NoCoda

The second step is constraint *demotion*, which executes in such a way that any winner-mark, if not dominated by at least one loser-mark in the same pair, will be demoted immediately below the highest-ranked loser-mark. NoCoda, the winner mark in (3-7), is thus demoted below the loser-mark Max, shown below.

(3-8) Constraint demotion for /C_1VC_2/[2]

/C_1VC_2/	*CC	NoCoda	Dep	Max	NoCoda
C_1V				*!	
✓☞ C_1VC_2		*			*

In the new ranking, the optimum for another input /$C_1C_2VC_3$/ is [C_2VC_3]. Suppose the observed TL form for the same input is [$C_1C_2VC_3$]. Another mark data pair can be formed as (3-9).

[2] The tick "✓" indicates the observed positive datum; the index "☞" denotes the candidate selected by the new grammar.

(3-9) Mark data pair for / $C_1C_2VC_3$/

loser	<	*winner*	*loser-marks*	*winner-marks*
[C_2VC_3]	<	[$C_1C_2VC_3$]	MAX, ~~NOCODA~~	*CC, ~~NOCODA~~

Note that in (3-9) the common marks between the winner and the loser are canceled. The demotion applies only to the remaining uncanceled marks.

(3-10) Constraint demotion for /$C_1C_2VC_3$/

/$C_1C_2VC_3$/	*CC	DEP	MAX	NOCODA	*CC
C_2VC_3			*!	*	
✓☞ $C_1C_2VC_3$	*			*	*

By demoting the uncanceled winner mark *CC below the loser mark MAX, the grammar selects the outputs that match the TL forms observed so far. For any other loser/winner pairs, if the current ranking guarantees that at least one uncanceled loser-mark dominates all the uncanceled winner-marks, the grammar learning can be regarded as completed.

Obviously, OT and CDA solve the “two fundamental problems” (White 2003b:36) that plague L2 acquisition theories: (i) the representational problem (i.e. what constitutes learners’ L2 knowledge), and (ii) the developmental problem (i.e. how they attain this knowledge). Due to these strengths, OT provides a promising tool capturing the E-tether in L2 acquisition, which will be discussed in the section that follows.

3.4 E-tether under the OT framework

The E-tether is exhibited in OT as the tendency of individuals to approximate the constraint ranking of the local E-grammar. This tethering effect can be most clearly seen by comparing how constraint demotion proceeds in purely laboratory setting where there is no E-tether and in social setting where the E-tether plays a role.

In purely laboratory setting (such as the learning depicted in §3.3), the only trigger for constraint demotion is the *input data* received by L2 learners. Any inconsistency between the observed TL forms and the outputs generated by the current grammar will lead to a change of the I-grammar. The target L2 ranking is expectedly attainable when sufficient amount of input data are provided. An illustration of such learning process is shown below.

(3-11) Constraint demotion in laboratory setting

$R_{INITIAL}$: C_1, C_2, C_3, C4 >> $\mathbf{C_5}$ >> C_6

Datum i: favors C_6 over C_5

⇩

R_2: C_1, C_2, C_3, $\mathbf{C_4}$ >> C_6 >> $\mathbf{C_5}$

Datum ii: favors C_5 over C_4

⇩

R_3: C_1, C_2, $\mathbf{C_3}$ >> C_6 >> C_5 >> $\mathbf{C_4}$

Datum iii: favors C_5 over C_3

⇩

R_4: C_1, $\mathbf{C_2}$ >> C_6 >> C_5 >> $\mathbf{C_3}$, C_4

Datum iv: favors C_5 over C_2

⇩

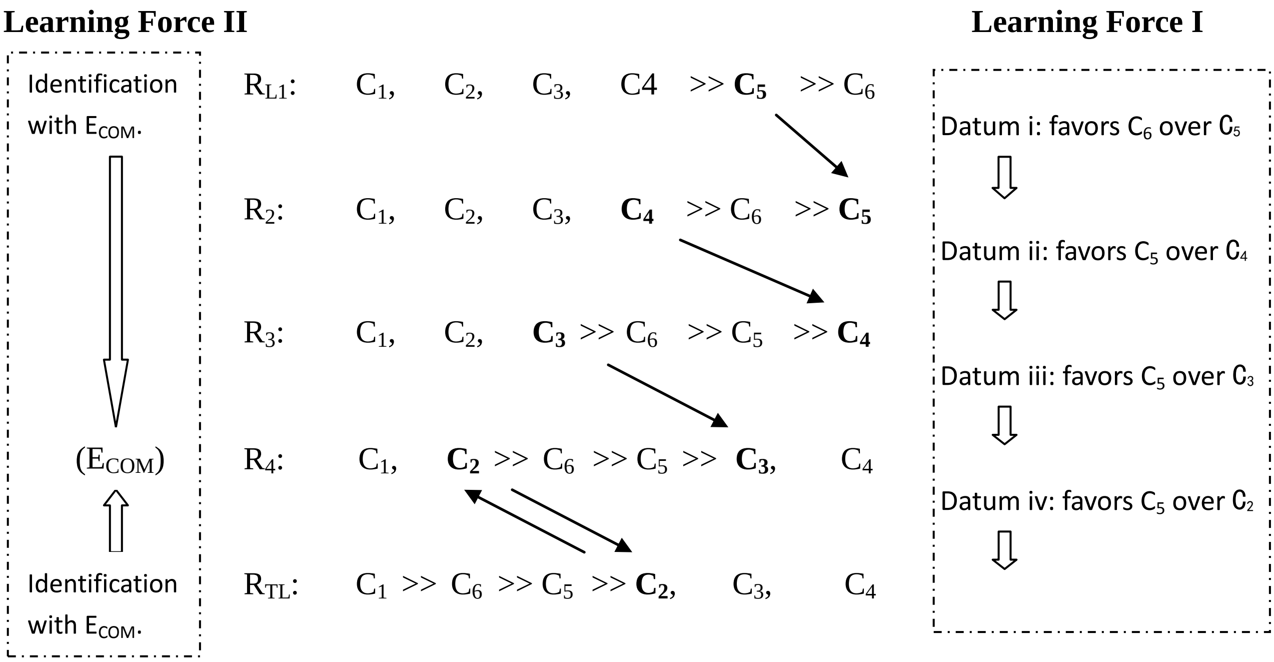
R_{TL}: C_1 >> C_6 >> C_5 >> $\mathbf{C_2}$, C_3, C_4

Legend: C_1, C_2, C_3, C_4, C_5 are different constraints. $R_{INITIAL}$ and R_{TL} denote the initial ranking of L2 acquisition and the TL ranking respectively; R_2, R_3, R_4 are the intermediate rankings during acquisition.

In (3-11), grammar learning is represented as the demotions of constraints. Each demotion move is accompanied by the occurrence of an informative input datum, i.e. the datum indicating which constraint to be demoted. The sequence of the demotions moves depends on the occurrence order of the input data. It is possible that the individual grammars in a community converge on a certain ranking (say, the R_4 in (3-11)), but such common pattern will have little effect. The demotion will proceed towards R_{TL} as long as the necessary input data are provided.

In social context, constraint demotion is influenced both by the *input data* and by the learners' *attitudes* towards the local variety of L2. This follows the ETT's argument that the learners' identification with the local community will drive them towards the corresponding E-grammar (i.e. $E_{COMMUNITY}$). The E-tether is hence expressible as the preference for the constraint ranking of $E_{COMMUNITY}$, illustrated as (3-12) using the same set of constraints.

(3-12) Constraint demotion in social setting



Legend: R_4 is meanwhile the ranking of the E-grammar prevalent in the learners' community, abbreviated as E_{COM}.

In (3-12), constraint demotion is still spurred by the error-driven learning resulted from the input data. The learners' identification with $E_{COMMUNITY}$ functions as another force, leading them towards R_4. Such identification acts like a two-edged sword. Where $E_{COMMUNITY}$ is consistent to the TL input, group identification facilitates the re-ranking towards the TL. Where $E_{COMMUNITY}$ is incompatible with the TL input (in this case the "Datum iv"), group identification prevents the progression towards the TL. This is shown in (3-12) as the tendency to maintain the $C_2 >> C_5$ ranking in R_4.

The incorporation of OT and attitudinal factors is not novel. There are OT studies suggesting that language learners may actively structure their grammars according to their subjective attitudes. For example, in a study on the sociolinguistic variation in Colloquial Arabic, Habib (2008) proposes several socially-motivated OT constraints, such as *[ʔ] and *[q]. Habib argues that the interaction between these constraints and other OT constraints captures Arabic speakers' preference for the sounds from certain Arabic varieties than others.

In Cutillas-Espinos (2004), the grammar of the local community (i.e.

$E_{COMMUNITY}$) is directly granted a place in OT. Cutillas-Espinos argues that grammar learning is simultaneously affected by three grammars. One is the standard grammar of the TL (G_1); the other is the vernacular grammar of a learner's local community (G_3). There is an intermediate grammar (G_2), which is the learner's actual grammar whose ranking lies in between G_1 and G_3. Represented through the constraints in stochastic OT (Boersma & Hayes 2001), G_2 is argued to be dynamic, ranging between the ranking values of G_1 and G_3 to meet various social and personal needs. That way, G_3 functions as a reference grammar for expressing identity, akin to the proposed E-tether.

The above two studies are certainly insightful. Though they are not designed to study L2 acquisition, the point is clear that "the speaker modulates his/her own constraint ranking to accommodate the extralinguistic context, to project a desired self-image or to build an identity" (Cutillas-Espinos 2004:175), and hence "grammar is no longer seen as a fully automatic mechanism" such as the pure CDA in laboratory setting (cf. (3-11)). Due to its capability in capturing the interplay between social and linguistic factors, an OT analysis is employed in this dissertation to unveil the effects of the E-tether.

3.5 Summary

Optimality Theory has been presented in this chapter as a useful tool describing the ETT. The rankings of the universal constraints in OT allow for the description of I-grammars and E-grammars. The re-ranking of the constraints, in the form of constraint demotions, characterizes the dynamics involved in L2 acquisition. The E-tether, manifesting itself as the desire for the constraint ranking of $E_{COMMUNITY}$, functions as an external force affecting the constraint demotions.

To verify the E-tether, it is essential to know whether the preference for the constraint ranking of $E_{COMMUNITY}$ is the case. This calls for experiment which is able to discover the ranking of $E_{COMMUNITY}$ and to check whether there is congruence between $E_{COMMUNITY}$ and the learners' attitudinally idealized grammar. An experiment serving this purpose will be introduced in Chapter Four.

Chapter Four[♠]

The E-Tether Experiment

The E-tether has been shown as the tendency of individuals towards the OT constraint ranking of the E-language spoken in their community. The attempts testing the E-tether Theory (ETT) should thus indicate the similarities and differences in the constraint rankings of the relevant I-grammars and E-grammars. This chapter presents an experiment examining the ETT through the acquisition of English consonant clusters by Cantonese speakers in Hong Kong and Guangzhou. §4.1 gives an overview of the experiment; §4.2 introduces the informants; §4.3 presents the L2 structures through the acquisition of which the ETT is examined; §4.4 shows how the technique of reverse language was incorporated to give an accurate description of I-grammars; §4.5 provides the experiment procedures; §4.6 finally presents how the data are analyzed.

4.1 Aim of the experiment

The ETT is testable based on its prediction, shown as (4-1):

(4-1) Prediction of the ETT

> L2 speakers in a community will attitudinally converge on the E-grammar of their own community.

To check the prediction, two types of information are needed: (i) the *I-grammars* of individual speakers, and (ii) the *E-grammar* of the community, from which one may then observe the tethering effect, which as shown in §3.4 is measurable in terms of the differences in constraint hierarchies in relation to the individual's attitudes towards $E_{\text{COMMUNITY}}$. The key information can be obtained in the following ways:

(4-2) Ways to obtain the key information

> (a) I-grammar: obtained from the linguistic performance of individuals

♠ The production data in this experiment are from the research project supported by the grant GRFHKBU250712 (P.I., Lian-Hee Wee).

through which the competence can be tapped into.

(b) E-grammar: generalized from the common properties of individual I-grammars, usually through corpus.

Crucially, a comparison between the constraint hierarchies of the E-grammar in (4-2-b) and the grammars individual learners actually prefer, which can be revealed through language attitude tests, will illuminate whether or not the E-tether exists. To make such a comparison, an experiment was implemented through the acquisition of English consonant clusters by native Cantonese speakers in Hong Kong and Guangzhou. The experiment consists of: (i) a production test obtaining I-grammars and E-grammars, and (ii) an attitudinal test examining the L2 speakers' attitudes toward $E_{COMMUNITY}$ as opposed to other L2 varieties. The experiment is summarized as (4-3), with the details presented in the ensuing sections.

(4-3) Overall experiment design

- Experiment
  - Production test
    - **Aim:** to obtain the individual I-grammars and the E-grammar in each city.
    - **Informants:** Hong Kong and Guangzhou English speakers whose L1 is Cantonese.
    - **Task:** informants read tested words.
  - Attitudinal test
    - **Aim:** to examine L2 speakers' attitudes toward $E_{COMMUNITY}$ as opposed to other L2 varieties.
    - **Informants:** same as the production test.
    - **Task:** Informants make preference judgments for the forms representing different constraint rankings.

4.2 Informants

The experiment focuses on the English spoken by Cantonese speakers. The informants are the native Cantonese speakers in Hong Kong and Guangzhou who have a good command of English. The two cities are studied because they on the one hand have the same Cantonese L1 background, and on the other are different in terms of the roles and social functions of English (see §1.5 for detailed explanations). The experiments done in the two cities thus allow one to test the ETT twice.

The basic information of the informants in the Hong Kong study and in the Guangzhou study are shown in (4-4) and (4-5) respectively. The informants in each city were divided into the primary group and the additional group whose participation was to ensure the reliability of the attitudinal test.

(4-4) Informants in the Hong Kong study

	Primary informants	**Additional informants**
Number	10 (5 females/5 males)	120 (99 females/21 males)
Participated in	Production & Attitudinal test[1]	Attitudinal test
L1	Cantonese	Cantonese
Age	20-31	18-27
Education level	Undergraduate or above	Undergraduate

(4-5) Informants in the Guangzhou study

	Primary informants	**Additional informants**
Number	10 (5 females/5 males)	56 (53 females/3 males)
Participated in	Production & Attitudinal test	Attitudinal test
L1	Cantonese	Cantonese
Age	19-25	18-23
Education level	Undergraduate or above	Undergraduate

The informants in each city were demographically similar. It has been ascertained that Cantonese is their mother tongue and the language they use most often in daily life, especially at home. The informants in the two cities also reported the ability to speak Mandarin, which is unsurprising given the availability of Mandarin courses in the curriculum of middle schools and universities in Hong Kong. Yet the Mandarin proficiency of the Guangzhou speakers is much higher than the Hong Kong speakers. Though the informants in both cities can speak English, their experience of learning English vary to some extent. Most of the

[1] One of the primary informants in the Hong Kong study attended only the production test.

Hong Kong informants started learning English at kindergarten around the age of 3. They all attended local universities where the medium of instruction is English. The Guangzhou informants, on the other hand, started learning English at primary school, ranging between the age of 7 and the age of 10. They received undergraduate education at Chinese-medium universities in mainland China. However, they still needed to keep learning English and attended English classes in order to pass the nationwide College English Test Band 4 and the College English Test Band 6 which are the requirement of graduation in many universities. Given that the informants all received undergraduate education or above, they can be regarded as educated speakers of English in their respective communities, who constitute a large proportion of the actual English users in Hong Kong and Guangzhou.

For the ease of identification, each primary informant was coded according to their city of origin, gender, and age. For example, a Hong Kong female informant whose age was 23 would be coded as HK-F-23-01. Whenever there was a second informant whose demographic information was identical, the second one would be coded as HK-F-23-02.

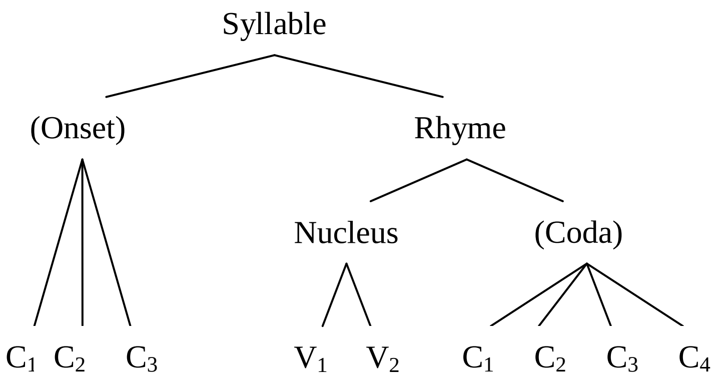
4.3 Testing ETT through cluster acquisition

The validity of the ETT is demonstrated through the lens of phonology, the aspect of language that is more sensitive to regional and social differences (Hudson 2000:42). Specifically, this research looks at the acquisition of English consonant clusters by native Cantonese speakers. For two reasons this decision is made. First, consonant clusters are allowed in the standard varieties of English (StdE)[2] but are unaccepted in Cantonese. Second, the modification of consonant clusters is popular in the English spoken by Cantonese speakers.

The StdE allows for up to three segments in onset, four segments in coda, and two vowels in nucleus (Roach 2000:57ff.), illustrated as (4-6). The nucleus is the compulsory component of a syllable, while the onset and the coda are optional, indicated by the parentheses in (4-6).

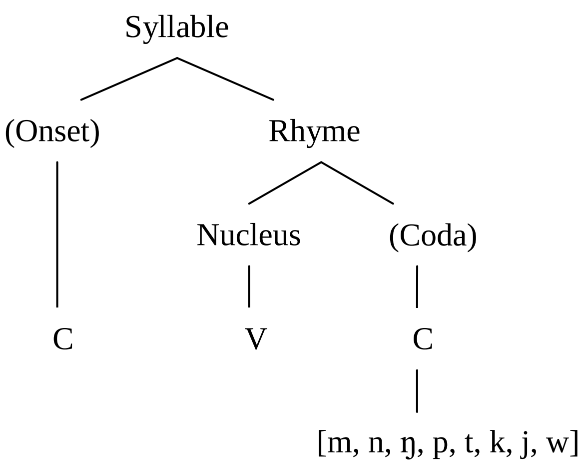
[2] Traditionally, standard varieties can refer to British English, American English, or other "inner-circle" varieties, but these varieties do not have major differences in consonant clusters.

(4-6) English syllable structure



Cantonese syllable contains onset and rhyme. The rhyme can be divided into nucleus and coda. Similar to English, the nucleus is obligatory, whereas the onset and the coda are optional, allowing for only one segment (Bauer & Benedict 1997:314ff.). The nucleus may include a vowel or a syllabic nasal;[3] the coda can be a consonant ([m, n, ŋ, p, t, k]) or a semivowel. As such, the Cantonese syllable structure is described as (4-7).

(4-7) Cantonese syllable structure



As can be seen from (4-6) and (4-7), Cantonese has a simpler syllable structure than English, allowing for neither complex nuclei nor consonant clusters. Given the impact of the L1 on L2 acquisition (cf. §2.2), the acquisition of English consonant clusters is an aspect Cantonese speakers would find difficult, a liable case of the bottleneck problem. This view is further reinforced by the prior studies

[3] There are two syllabic nasals in Cantonese, namely /m/ and /ŋ/.

on Hong Kong English (HKE) where the modifications of consonant clusters have been widely reported (e.g. Hung 2000; Peng & Ann 2004; Yam 2005; Deterding 2006; Chan 2007, 2010; Lo 2007; Chiu 2008; Deterding, Wong, & Kirkpatrick 2008; Wee 2008, 2009; Setter et al. 2010). Guangzhou English (GZE), though relatively under-investigated, is likely to exhibit similar cluster modifications, since it shares the Cantonese L1 background.

Based on the above reasons, the English E-grammars in Hong Kong and in Guangzhou are prone to stagnate at a constraint ranking like (4-8) with respect to consonant clusters.

(4-8) Expected constraint ranking in HKE and GZE

*CC >> FAITH >> NOCODA

This constraint ranking contrasts with the StdE ranking shown in (4-9).

(4-9) Constraint ranking in the StdE

FAITH >> *CC, NOCODA

Though the actual constraint rankings are certainly more complicated, (4-8) and (4-9) suffice to show the difference between HKE and the StdE. Such difference makes cluster acquisition a viable test case for the ETT, because only through the differences in constraint ranking can we see to which E-grammar the L2 speakers are tethered towards.

With a focus on consonant clusters, a list with 180 English words was composed as the stimuli for the production test. The list includes the commonly seen onset and coda clusters.[4] Part of the list is shown in (4-10) (see Appendix 2 for the full list of the words). To keep the study in a manageable size, the dissertation focuses primarily on CC onsets and codas, though words containing singleton or CCC syllable margins may also be used as additional evidence for analysis.

[4] Considering that the underlying forms in an L2 may not be the same as those in the standard varieties (see the *RP Fallacy*, Mohanan 1992), certain clusters whose underlying forms are unclear in HKE are outside the word list. Chiu (2008), for instance, shows that there is no /kt/ or /ks/ coda in HKE because the /k/ is absent underlyingly. /kt/ and /ks/ are hence not considered in this experiment.

(4-10) Partial list of the tested words

Position	Onset			Coda			
Cluster	/pr/	/sp/	/fl/	/pt/	/nt/	/ns/	/ft/
Word	pray	spa	fly	kept	grant	ounce	lift

4.4 The involvement of reverse language

To confirm whether consonant clusters are acquired by the L2 speakers at phonological level, a language game (reverse language) was utilized in addition to the normal-order speech. This follows Kenstowicz's (1994:6f) insight that phonological representations (or "structural representations" in the term of OT) are abstract, sometimes difficult to identify simply from normal speech. The adjacent consonants in normal-order speech, for example, do not necessarily form a syllable constituent (e.g. onset, coda). Take the word *last* as illustration. It can be mentally parsed by a speaker as [last], [las.t] or [la.s.t], though the three forms are phonetically similar.

As Kenstowicz (1994:7) suggests, "[phonological representation] may be revealed in language games (e.g. "Say *writer* or *anchor* backward") and judgments of poetic rhyme".[5] Reverse language, a language game that requires speaker to read words backwardly (similar to Verlan, a French-originated language game; see Bagemihl 1995, Peters 2006), was thus employed in this study to ascertain the relation between consonant adjacency and constituency.

For polysyllabic words, the sequence of syllables is simply inverted in the reverse language. To avoid influencing the informants' judgments on English syllables, the rule of reversal was demonstrated to the informants through Cantonese examples as (4-11).

(4-11) Reversal of polysyllabic words in the reverse language

	Normal order		Reverse order	Gloss
	$\boldsymbol{\sigma_1\ \sigma_2}$	⇨	$\boldsymbol{\sigma_2\ \sigma_1}$	
e.g.	[p^{h}ing.kwo]	⇨	[kwo.p^{h}ing]	"apple"

[5] A similar point is made in White (2003a:17), though not restricted to phonology, as follows: "linguistic competence is an abstraction; there is no way of directly tapping that competence. Hence, researchers must resort to various kinds of performance measure in order to determine, indirectly, the essential characteristics of mental representations".

	$\sigma_1\ \sigma_2\ \sigma_3$	⇨	**$\sigma_3\ \sigma_2\ \sigma_1$**	
e.g.	[tsy.ku.lik]	⇨	[lik.ku.tsy]	"chocolate"

The informants then are expected to apply the above rules to English polysyllabic words such as *fabric* and *spiritual*.[6]

For monosyllabic words, the elements that undergo reversion are the internal constituents within a syllable, shown to the informants through Cantonese examples as (4-12).

(4-12) Reversal of monosyllabic words in the reverse language

Normal order		Reverse order	Gloss
[tʌk]	⇨	[kʌt]	"OK"
[tip]	⇨	[pit]	"stack"
[pak]	⇨	[kap]	"white"

Both types of reverse utterances will give important information on the nature of consonant clusters in one's mind. The reversal of monosyllabic words will shed light on how speakers mentally divide a syllable into different parts, especially when consonant clusters are involved. Crucially, the reversal patterns will reveal whether adjacent consonants are treated as a whole constituent. Meanwhile, the reversal of polysyllabic words will provide insights on the syllabification in L2, as "evidence from ludlings shows that speakers of different languages recognize syllables, but do not divide words into syllables in the same way" (Peters 2006:3).

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[6] For disyllabic words, the reversal simply requires one to invert a $\sigma_1\sigma_2$ sequence into $\sigma_2\sigma_1$. The reversal of words with three syllables, however, involves some complications. A $\sigma_1\sigma_2\sigma_3$ sequence can be changed into, for example, $\sigma_3\sigma_2\sigma_1$ or $\sigma_2\sigma_3\sigma_1$. A word such as *spiritual* thus can be inverted as *tual.ri.spi* or *ri.tual.spi*. If the word is reversed as *tual.ri.spi*, it can be understood as an inversion of syllable sequence in that a $\sigma_1\sigma_2\sigma_3$ sequence becomes $\sigma_3\sigma_2\sigma_1$. The [spi] can therefore be regarded as a single syllable and the [sp] is the onset of the syllable. If the word is reversed as *ri.tual.spi*, complications may arise. We may interpret this as a $\sigma_1\sigma_2\sigma_3$ sequence changing into $\sigma_2\sigma_3\sigma_1$. Alternatively, *ri.tual.spi* can be understood as the reversal of two feet *ri.tua*l and *s.pi*, when the [s] in [sp] is treated as a consonantal syllable. Fortunately, such complex $\sigma_1\sigma_2\sigma_3 \rightarrow \sigma_2\sigma_3\sigma_1$ reversal does not show up in the actual data, and hence the applicability of the reverse language is not affected.

4.5 Experiment procedures

The whole experiment consists of a production test and an attitudinal test.

4.5.1 Production test

The purpose of the production test is two-fold. Firstly, it collected data for the I-grammar of individual speakers. Secondly, from the aggregate of the individual data the E-grammar of HKE and of GZE can be generalized.

The 10 primary informants (cf. (4-4), (4-5)) in each city joined the production test, which was administered individually. As the experiment required both the normal-order and the reverse utterances of the tested words, the production test began with the instruction of the reversal rules (cf. (4-11) and (4-12)), introduced to the informant through Cantonese examples as follows:

(4-13) Cantonese examples of the reverse language

Tri-syllabic words:	[ji.tai.lei] ⇨ [lei.tai.ji] [san.k^{h}a.la] ⇨ [la.k^{h}a.san] [si.t^{h}ou.wa] ⇨ [wa.t^{h}ou.si]	"Italy" "remote" name
Disyllabic words:	[p^{h}ing.kwo] ⇨ [kwo.p^{h}ing] [dik.si] ⇨ [si.dik] [tin.nou] ⇨ [nou.tin]	"apple" "taxi" "computer"
Monosyllabic words:	[tʌk] ⇨ [kʌt] [tip] ⇨ [pit] [pak] ⇨ [kap]	"OK" "stack" "white"

The use of Cantonese ensured that the informant was taught with the reversal rules without explicitly being told what should do to the English syllables. The informant thus had to rely on his/her intuition to produce the English reversals.

After the training, the informant was to provide both the normal-order and the reverse utterances of the tested words (see Appendix 2), with each word recorded separately. The informant's utterance attempts for a given word were elicited through a dialog between the informant and the experimenter, shown as (4-14).

(4-14) Elicitation procedure

Experimenter: *What was it?*/*What do you say?*[7]

⇩

Informant: *It was* <normal utterance>/ *I say* <normal utterance>.

⇩

Experimenter: *What was it?*/*What do you say?*

⇩

Informant: *It was* <reverse utterance>/ *I say* <reverse utterance>.

Each time of recording gave one normal-order token and one reversal. All the tested words were randomized and presented to the informant three times, giving three normal and three reverse utterances for each word.

The recording procedure was undertaken in a quiet and comfortable environment (mostly the Phonology Lab at Hong Kong Baptist University) over multiple sessions to avoid fatigue. The recordings were made under the condition of Praat (Boersma & Weenink 2013), with a sampling frequency 22050 Hz. It was fine for the informant to request a retry, as the experiment concerned more on the speaker's linguistic competence than on performance (cf. Chomsky 1965:4).

The recordings were transcribed manually by two phonetically-trained transcribers. One transcriber dealt with 14 speakers and the other dealt with the remaining six. To ensure accuracy, spectral measurement was also employed when necessary. For uncertain tokens, the two transcribers discussed and made the final decision.

4.5.2 Attitudinal test

What followed was an attitudinal test investigating the informants' degree of preference for the constraint rankings of HKE and GZE.

The individual data gathered from the production test were pooled together to form a mini-corpus of HKE and another of GZE. From the corpus data, the general phonological patterns in HKE and in GZE were identified. These patterns constitute the E-grammars prevailing in the speakers' community and were used as part of the stimuli for the attitudinal test.

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[7] For spectral analysis, the choice of the prompt questions depended on the first segment of the normal/reverse utterance. If the utterance began with a voiced sonorant, the prompt "*What was it?*" was used; otherwise, "*What do you say?*" was used. To ascertain the first segment, the informant was required to pronounce the presented word and provide its reverse form before the recording.

Specifically, the stimuli cover a range of possible ways to pronounce English consonant clusters together with the forms from the StdE. For each cluster, there can be up to four variants which represent four distinct constraint rankings, shown as (4-15) on page 49. The informants were asked about their degree of preference for the different versions of pronunciation.

The stimuli include 36 tested words which produce 141 variant stimuli in total (see Appendix 4 for the full list of stimuli). For example, the variants for the word *east* include [iːstʰ], [iːs], [ˈiː.s.tʰə], and [iːs.t̩ʰ]. Upon hearing a variant, the informants were to rate a statement in a 5-point Likert scale, presented as (4-16). Through question of this kind the mechanism underlying the choice of target grammar will be illuminated.

(4-16) Language attitude question[8]
I like the way it is pronounced.
Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly disagree

There may be a variety of ways to interpret the statement "I like the way it is pronounced", e.g. intelligent, competent, cute, friendly. The purpose of this general statement, however, is to examine whether there is an alignment between the grammar the subjects attitudinally prefer and the actual E-grammar of the subjects' community, regardless of the specific feelings underlying the preference. As long as there is or is not an alignment, the goal of testing the E-tether Theory will be fulfilled. If more detailed questions are used rather than focusing on the general statement "I like…", the experiment results would be hard to interpret and it would be difficult to determine if there is an alignment. Yet the specific reasons of the liking are certainly important but will have to await the future studies.

The experiment adopted the Matched Guise Technique (Lambert, Hodgson, Gardner & Fillenbaum 1960). That is, all the stimuli were produced by the same phonetically-trained speaker in order to avoid speaker-related variables and draw attention to language itself (Cavallaro & Ng 2009). The Matched Guise Technique

[8] A question that may arise is if liking entails doing. However, given the pronunciation patterns observed in the production test, whether or not liking will result in doing is no longer the point here. What the L2 speakers in Hong Kong and Guangzhou do is already known. The crucial thing here is to test whether the observed pronunciation patterns are identified with by the subjects. If the Hong Kong speakers do not accept the observed HKE patterns or the Guangzhou people dislike the GZE grammar, the ETT will be falsified.

(4-15) Categories of the attitudinal stimuli

Category	**Syllable structures**	**Ranking testing for**	**Example**
Consonant deletion	/CVCC/ → [CVC] /CCVC/ → [CVC]	*CC >> DEP, *OBSNUC >> MAX	/iːst/ → [iːs] “east” /plei/ → [pʰei] “play”
Vowel epenthesis	/CVCC/ → [CVC.CV] /CCVC/ → [CV.CVC]	*CC >> MAX, *OBSNUC >> DEP	/ænt/ → [æn.tʰə] “ant” /kliːn/ → [kʰə.liːn] “clean”
Syllabic obstruent[7]	/CVCC/ → [CVC.C] /CCVC/ → [C.CVC]	*CC >> MAX, DEP >> *OBSNUC	/iːst/ → [iːs.t̩ʰ] “east” /plei/ → [p̩ʰ.lei] “play”
Standard English forms	/CVCC/ → [CVCC] /CCVC/ → [CCVC]	MAX, DEP, *OBSNUC >> *CC	/iːst/ → [iːstʰ] “east” /plei/ → [pʰlei] “play”

[7] The syllabic obstruent was made by accentuating and lengthening the obsturent.

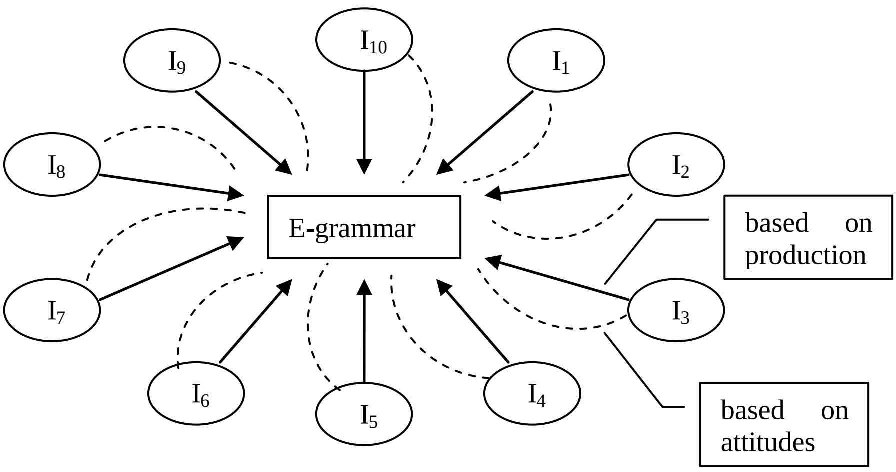
was possible here because consonant clusters are relatively easy to mimic by a single speaker. Given that the stimuli were in citation forms, the difficulty of mimicking further decreased. As such, the stimuli were made by a male speaker and saved as WAV files.

Besides the primary informants, another 120 additional informants from Hong Kong and 56 from Guangzhou (cf. (4-4), (4-5)) attended the attitudinal test to enhance reliability. The test took around 40 minutes and was conducted either in the Phonology Lab at HKBU or in a classroom with a well-equipped audio system. Necessary instruction was given beforehand. The words in question were shown on the question sheet (see Appendix 3). Each variant stimulus was played twice so that the informants could hear it clearly.

4.6 Process of analysis

The data obtained from the production and the attitudinal tests enable an examination of the ETT. From the production data, one can find the I-grammar of individual informants based on which the E-grammar of HKE and of GZE can then be established. The attitudinal data allow one to confirm if the two E-grammars are identified with by the Hong Kong people and by the Guangzhou people as is predicted by the ETT. The logic underlying the data analysis can be summed up as (4-17).

(4-17) A schematic diagram of the analysis



As (4-17) shows, two types of relation between the E-grammar and the individuals will be addressed. Firstly, the E-grammar of a city will be generalized from the aggregate of the 10 individual I-grammars, indicated by the arrows.

Secondly, whether the E-grammar has a tethering effect on the individuals (shown as the dotted lines) will be unraveled through the attitudinal data. How the two types of relation are analyzed will come in §4.6.1 and §4.6.2.

4.6.1 The establishment of E-grammar through I-grammars

To generalize the E-grammar of HKE and of GZE, the I-grammars of the 10 primary informants in each city will first be described based on their productions of consonant clusters. The clusters in the normal-order utterances can be classified as (4-18) depending on whether the clusters are preserved or how they are repaired.

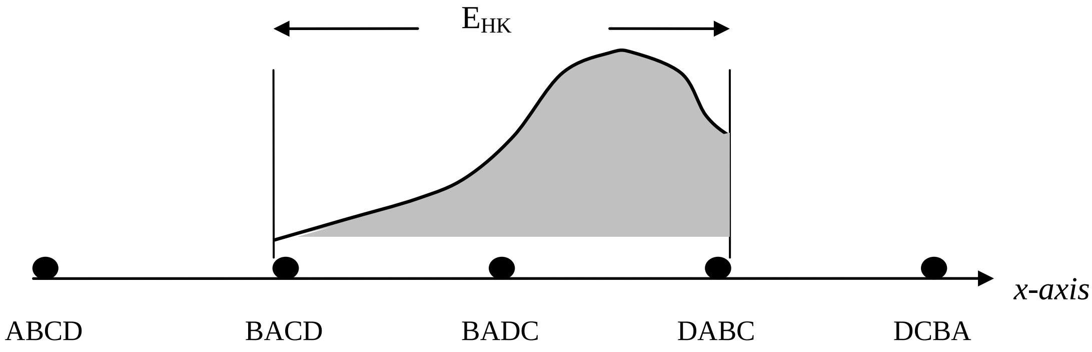
(4-18) Classification of normal-order utterances

	Type	Description
I	**Cluster preservation**	The cluster is preserved in the surface form.
		E.g. /pɹei/ → [pɹei] “pray”; /lend/ → [lend] “lend”
II	**Repairing strategies**	
	a. Deletion	One or more cluster member is absent.
		E.g. /pɹei/ → [pei] “pray”; /lend/ → [len] “lend”
	b. Vowel epenthesis	One or more vowel is inserted to the cluster.
		E.g. /pɹei/ → [pu.ɹei] “pray”; /lend/ → [len.də] “lend”

The reverse utterances are also scrutinized to see if the “clusters” produced by the informants are phonologically true clusters. This is done by observing whether the adjacent consonants in the normal speech are preserved as a constituent in the reverse language. For instance, if the word *closure* is produced as [klou.ʃə] in the normal speech but as [ʃə.louk] in the reverse form, it is more reasonable to consider the prevocalic [kl] in the normal form as a syllabic obstruent [k] plus a simple onset [l], rather than a complex onset.

From both the normal and the reverse speech, the I-grammar of each primary informant is identified, expressed as OT constraint ranking. Given that an E-grammar is the grammar that generates the totality of utterances (i.e. the E-language) in a community (Chomsky 1986:19), the E-grammar of each city is represented as a range of constraint rankings covering the 10 I-grammars,[8] exemplified as (4-19).

(4-19) A schematic representation of E-grammar



A, B, C, and D in (4-19) denote different constraints. Their sequence indicates the ranking of the constraints (e.g. ABCD means A >> B >> C >> D; DCBA means D >> C >> B >> A). The discrepancy between the rankings ABCD and DCBA reduces along the x-axis from left to right, following a measurement of ranking distance developed out the *r-measure* proposed by Prince & Tesar (2004) (see Appendix 1 for the detailed introduction to the measurement). Suppose the I-grammars of the Hong Kong informants fall under either of the ranking BACD, BADC, or DABC. The E-grammar of HKE is shown as a range covering the three rankings. The internal distribution of the E-language data is shown through the curve. To demonstrate the major cluster repairing strategies in this range, the occurring frequencies of some crucial sub-rankings will also be counted across the 10 I-grammars. For example, the sub-ranking B >> A holds for all informants whose I-grammar falls in the ranking BACD or BADC.

4.6.2 The verification of the E-tether through E-grammar

To verify the tethering effect of the identified E-grammars on the Hong Kong people and on the Guangzhou people, the people's degree of preference for the different constraint rankings in the attitudinal test (cf. (4-15)) will be looked into. This relies on a statistical analysis of the attitudinal data, with each city studied

[8] One may question if the ten primary informants in each city can reflect HKE and GZE. However, given the balance in gender and the representativeness of the informants for the English-speaking community in Hong Kong and in Guangzhou (cf. §4.2), the E-grammar generalized from the 10 informants can be regarded as an approximation of the actual E-grammar in each city.

separately. For each cluster, the highest-rated variant stimulus is identified. A Student-Newman-Keuls (SNK) test (p = 0.05) is also implemented to confirm whether the differences between the ratings are statistically significant. The attitudinal judgments for all clusters are finally put together to determine the constraint ranking the informants attitudinally prefer. It is then possible to see whether, and to what extent, the preferred constraint ranking matches the actual E-grammar of HKE and of GZE.

4.7 Summary

The E-tether Theory is tested in this dissertation through the acquisition of English consonant clusters by the Cantonese speakers in Hong Kong and Guangzhou. The productions of consonant clusters by 10 informants from Hong Kong and 10 from Guangzhou were collected to obtain I-grammars and E-grammars. The I-grammars are identified on an individual basis; the E-grammar in each city is generalized from the aggregate of the individual data. The technique of reversed language was also adopted to ascertain whether the clusters have been acquired at phonological level.

What followed was an attitudinal test checking the tethering effect of the identified E-grammar in each city. Under the matched-guise paradigm, the informants listened to different ways producing English consonant clusters and made preference judgments for the perceived stimuli. Statistical analysis is implemented to determine the pronunciation patterns preferred by the informants, from which the grammar attitudinally favored by the informants is deduced.

The experiment results are formalized under the framework of OT, within which both I-grammars and E-grammars are expressible as the rankings of universal constraints. The tethering effect is assessed by comparing the ranking of the E-grammar in a city with the informants' preferred ranking found in the attitudinal test. On this ground, an observation on the applicability of the ETT is attainable.

Chapter Five

Empirical Validation:

The Hong Kong Study

Based on the experiment presented in Chapter Four, this chapter examines the E-tether Theory (ETT) through the acquisition of English consonant clusters by the Cantonese L1 speakers in Hong Kong. According to the ETT, the English speakers in Hong Kong are predicted to be attracted towards the E-grammar of Hong Kong English (HKE). If the prediction is true, the Hong Kong people should exhibit a pronunciation pattern distinct from the standard varieties of English (StdE) as to consonant clusters and perceive the pattern positively.

§5.1 addresses the I-grammars of individual speakers, from which §5.2 identifies the E-grammar of HKE. §5.3 shows to what extent the Hong Kong people incline towards the OT constraint ranking of HKE as opposed to other grammars, based on the findings of a language attitude test. §5.4 provides additional evidence supporting the ETT outside the domain of cluster acquisition. §5.5 gives a summary.

5.1 Typology of I-grammars

The section describes the I-grammars of 10 Hong Kong informants with respect to CC clusters, drawing evidence from the production test (cf. §4.5.1). This description facilitates the discovery of the E-grammar of HKE, and also enables the capture of changes in the mental grammar during various stages of L2 acquisition. It turns out that the ten I-grammars can be classified into the six types shown in (5-1), depending on whether consonant clusters undergo modifications and how they are modified.

(5-1) Typology of I-grammars

<u>Type I</u>

Number of speakers: 1

Description: Obstruent syllabification in /s/-stop onsets, continuant obstruent codas, and CC codas.

Type II

Number of speakers: 1

Description: Obstruent syllabification in /s/-stop onsets and continuant obstruent codas.

Type III

Number of speakers: 1

Description: Deletion of obstruent-liquid onsets and homorganic coda clusters.

Type IV

Number of speakers: 1

Description: Obstruent syllabification in continuant obstruent codas.

Type V

Number of speakers: 3

Description: Deletion of homorganic coda clusters.

Type VI

Number of speakers: 3

Description: Faithful preservation of consonant clusters.

How each of the six I-grammar types is established and formalized in OT constraint rankings will come in §5.1.1 to §5.1.6. A summary of the I-grammar constraint rankings will be offered in §5.1.7.

5.1.1 Type I: Obstruent syllabification in /s/-stop onsets, CC codas, and continuant obstruent codas

The Type I I-grammar in (5-1) is observed in one informant (HK-F-23-01). Following the analysis method introduced in §4.6.1, the I-grammar is determined through (i) the productions of consonant clusters in the *normal-order speech*, (ii) how the words containing clusters are produced in the *reverse language*, a language game requiring the inversion of syllable sequence for polysyllabic words, and of syllable internal constituents (e.g. onset, coda) for monosyllabic words (cf. §4.4 for the introduction of the reverse language).

In the normal-order speech, CC onsets and CC codas are preserved in most cases (see Appendix 8 for the list of transcriptions). The only modification that systematically occurs is the replacement of word-final voiced obstruents by their voiceless counterparts, exemplified below.

(5-2) Devoicing of word-final obstruents

	Word-final stops			Word-final fricatives	
a.	[lentʰ]	"lend"	d.	[ɹeintʃ]	"range"
b.	[bekʰtʰ]	"begged"	e.	[ʃelf]	"shelve"
c.	[klʌptʰ]	"clubbed"	f.	[bɹoŋs]	"bronze"

The final obstruent devoicing[1] above, however, is not due to clusters themselves, since singleton obstruent codas also undergo devoicing, e.g. [kjupʰ] for *cube*, [eitʃ] for *age*. Given the prevalence of final devoicing among the Hong Kong informants, this phenomenon will be discussed separately in §5.4 as another case illustrating the ETT.

Prima facie, the informant does not seem to have fundamental difficulties with consonant clusters except for final devoicing. To further determine whether the adjacent consonants in the normal utterances form true constituents (i.e. complex onsets or complex codas), the reverse utterances (cf. §4.4) of the relevant words are also examined. First consider the examples in (5-3) which show how polysyllabic words which contain a complex onset are reversed.

(5-3) Reversal of polysyllabic word with a complex onset[2]

	Normal	**Reverse**	
a.	[klou.ʃə]	[ʃə.klou]	"closure"
b.	[im.ploː.ə]	[ʌ.ploː.im]	"implore"
c.	[pɹe.si.dən.si]	[si.dən.si.pɹe]	"presidency"
d.	[ri.fɹi.dʒə.ɹei.tə]	[tə.ɹei.dʒə.fɹi.ri]	"refrigerator"
e.	[sdju.bit]	[pi.djus]	"stupid"

[1] The voiced-voiceless distinction for English stops may largely become an unaspirated-aspirated distinction in HKE and GZE. Final devoicing in this thesis refers to the cases where the distinction neutralizes to the voiceless/aspirated end.

[2] Since the thesis focuses on consonant clusters, suprasegmental information such as stress is not provided in the transcriptions.

f.	[skei.tiŋ]	[tiŋ.keis]	“skating”
g.	[sbi.ɹi.tʃou]	[tʃou.ɹi.bis]	“spiritual”
h.	[sbo.jəl]	[ou.bois]	“spoil”

From (5-3-a) to (5-3-d), the CC onsets in the normal utterances (e.g. [kl], [pl], [pɹ], [fɹ]) all are kept intact in the reverse forms. This indicates that the adjacent consonants do form a tight unit.

In (5-3-e) to (5-3-h), however, the [s]-stop “onsets” in the normal forms are split apart in the reverse utterances – the [s] moves away from the following stop and behaves as if a consonantal syllable. Take *skating* as example. If [sk] is treated as a complex onset, one would expect the word to be reversed as [tiŋ.skei], contrary to the actual reverse form [tiŋ.keis]. If the [s] is viewed as a syllable, the reversal can be easily explained: [s] is the first syllable in the normal form and becomes the last in the reversal, precisely reflecting an inversion of syllabic sequence, i.e. [σ_1 σ_2 σ_3] → [σ_3 σ_2 σ_1] (cf. (4-11)). The [s]-stop sequence in the normal utterances are hence more likely a syllabic [s] plus a stop onset rather than a true complex onset.

The syllabicity of the [s] is also evidenced by the reversal of monosyllabic words, presented below.

(5-4) Reversal of monosyllabic words beginning a with sC or sCC string

	Normal	**Reverse**	
a.	[spaː]	[paːs]	“spa “
b.	[sden]	[deŋs]	“stain”
c.	[sdaːr]	[daːrs]	“star”
d.	[spriŋ]	[priŋs]	“spring”
e.	[sdriŋ]	[triŋs]	“string”

For prevocalic /s/-stop strings ((5-4-a) to (5-4-c)), the reversion simply requires the [s] to exchange with the remaining word. For prevocalic /s/-stop-liquid strings ((5-4-d), (5-4-e)), the [s] is also the only segment that undergoes movement while the other part remains intact. Considering the reverse training presented to the informants (with the training examples [tʌk] → [kʌt], [tip] → [pit]; cf. (4-12)), the reversal pattern in (5-4) is an indication of the syllabicity of the [s]. Based on the training examples, one would expect *stain* to be reversed as [nest] (under the interpretation to exchange the constituents in onset and in coda), [nets] (under the interpretation to reverse the segmental sequence), or [ndes] (under the interpretation to exchange the initial and the final segments). The actual reverse form [deŋs] is consistent with none of the above readings but with the reversal of disyllabic words when the [s] is viewed as a syllable. The rule in (5-5) can then be postulated for the prevocalic [s]-stop sequences in the normal utterances.

(5-5) Syllabification of the [s] in prevocalic /s/-stop strings

$$\text{s}\ \underset{\begin{bmatrix}\text{-cont}\\ \text{-son}\end{bmatrix}}{\text{C}} \rightarrow \text{s}\,.\ \underset{\begin{bmatrix}\text{-cont}\\ \text{-son}\end{bmatrix}}{\text{C}}\quad /\ \#\_\_\ \text{V}$$

Legend: "cont" – continuant; "son" – sonorant; "**.**" – syllable boundary;
"**#**" – word boundary.

To derive the effect in (5-5) through OT, one needs the three constraints in (5-6).

(5-6) ***[σCC:**

Do not have complex onsets (Kager 1999:97).[3]

***ObsNuc:**

Do not have obstruent nuclei (Pater 1996:74).[4]

SSP-Ons:

Complex onsets rise in sonority (Kager 1999:267).

Among the three constraints, the key to explain why obstruent syllabification occurs to /s/-stop onsets but not to the other onsets is SSP-Ons, a constraint based on the Sonority Sequencing Principle (Clements 1990) which states that "the

[3] *CC is split as *[σCC and *CC]σ in the description of I-grammars, given the positional asymmetries as we will see among the Hong Kong and the Guangzhou speakers. This also resonates with the observation that some of the world's languages tolerate only the clusters at onset position while others tolerate only coda clusters (Ito 1986; Blevins 1995).

[4] *ObsNuc is based on the universal tendency to have sonorants than obstruents as nuclei (Prince & Smolensky 1993:141).

sonority profile of the syllable must rise until it peaks, and then fall" (Roca & Johnson 1999:255). While the majority of English CC onsets rise in sonority and thus conform to SSP-ONS, /s/-stop onsets are exceptions, illustrated through the sonority scale proposed by Selkirk (1984).

(5-7) Sonority scale (Selkirk 1984)
Glides > Liquids > Nasals > Fricatives > Stops

Legend: ">" indicates more sonorous than.

By putting the constraints in (5-6) in the ranking SSP-ONS >> *OBSNUC >> *[σCC, one can derive a grammar that treats /s/-stop onsets and the other CC onsets differently. Take /sp/ and /kɹ/ as examples. (5-8) shows how the correct outputs surface.

(5-8) Evaluation tableaux for *sky* and *cry*

a. /skai/ "sky"	SSP-ONS	*OBSNUC	*[σCC
skai	*!		*
☞ s.kai		*	

b. /kɹai/ "cry"	SSP-ONS	*OBSNUC	*[σCC
☞ kɹai			*
k.ɹai		*!	

In a similar manner, to determine if the adjacent consonants in coda position are true coda clusters, (5-9) shows the reversal of polysyllabic words which contain a CC "coda".

(5-9) Reversal of polysyllabic words containing a postvocalic CC string

	Normal	**Reverse**	
a.	[dʌi.dʒest]	[ts.dʒe.dʌi]	"digest"
b.	[eks.kon]	[kons.ek]	"ex-con"
c.	[in.di.pen.dənt]	[tdən.pen.di.in]	"independent"
d.	[seʔ.mənt]	[tmən.se]	"segment"
e.	[ai.tuns]	[stun.ai]	"i-Tunes"
f.	[si.kwəns]	[skwən.siː]	"sequence"

In (5-9), none of the "coda clusters" in the normal forms are preserved in the reverse forms. For the word *digest* in (5-9-a), the postvocalic [s] and [t] are split from the syllable [dʒe] and are moved before [dʒe] in the reverse form. Similarly, the [s] in *ex-con* (in 5-9-b) and the [t] in *independent* (in 5-9-c) are separated from the preceding /ek/ and /dən/ when the words are reversed. If the postvocalic CC strings are true codas, one would expect them to be retained in reverse forms and words such as *independent* should be reversed as [dənt.pen.di.in]. The fact that [tdən.pen.di.in] is produced indicates that the obstruent syllabification observed in /s/-stop onsets applies also to CC codas. By assuming the separated obstruents as syllables, one can then explain the reverse forms in (5-9)

With a closer look at (5-9), the obstruent syllabification can be divided into two types, depending on whether the C_1 in a postvocalic C_1C_2 string is preserved as coda. In the reverse form of *digest* (i.e. [ts.dʒe.dʌi]), both the C_1 [s] and the C_2 [t] are moved the same way as a syllable. For the other words, only the C_2 is split whereas the C_1 still follows its original syllable. Take *ex-con* and *independen*t as examples. The C_1 [k] and [n] are kept as coda in the reverse forms [kons.ek] and [tdən.pen.di.in]. The two co-existing reversion strategies reveal the following possibility: the postvocalic C_1 will be parsed as a syllable when it is a fricative; otherwise, the C_1 will be accepted as a coda consonant.

The distinction between fricative and non-fricative C_1 is also found in the reversal of monosyllabic words, presented below.

(5-10) Reversal of monosyllabic words ending with a CC string

	Normal	**Reverse**			**Normal**	**Reverse**	
a.	[ask]	[ks.a]	"ask"	f.	[kept]	[tkep]	"kept"
b.	[ist]	[ts.i]	"east"	g.	[læps]	[slæp]	"lapse"
c.	[laifs]	[sflai]	"lives"	h.	[blʌnt]	[tblʌn]	"blunt"
d.	[lisp]	[pə̥s.li]	"lisp"	i.	[lʌmp]	[plʌm]	"lump"
e.	[lift]	[tfliː]	"lift"	j.	[ɹeŋtʃ]	[tʃɹeŋ]	"range"

In (5-10), the reversal requires the final obstruent(s) in the normal forms to move to the left of the whole word. Interestingly, whether the C_1 in a postvocalic C_1C_2 string moves depends on if it is a fricative. The examples from (5-10-a) to (5-10-e) belong to the category where the C_1 is a fricative; (5-10-f) to (5-10-j) is another category where the C_1 is not a fricative. The reversion patterns of the two categories can be schematized as follows.

(5-11) The split/preservation of the postvocalic C_1C_2 string

	Normal		**Reverse**	**Condition**
a.	$C_0VC_1C_2$	$\rightarrow$	$C_2C_1C_0V$	(where C_1 is a fricative, e.g. *lift*)
b.	$C_0VC_1C_2$	$\rightarrow$	$C_2C_0VC_1$	(where C_1 is *not* a fricative, e.g. *kept, lump*)

The uniform split of the fricative C_1 (shown in (5-11-a)), as opposed to the preservation of other C_1 codas (e.g. [p], [m], [n] etc.),[5] suggests that the I-grammar may even parse singleton fricative "codas" as a syllable. This is indeed borne out by the data, shown through the examples in (5-12).

(5-12) Reversal of polysyllabic words ending with a singleton consonant

	Normal	**Reverse**	
a.	[fu.liʃ]	[ʃli.fuː]	"foolish"
b.	[ʃem.les]	[sle.ʃem]	"shameless"
c.	[re.pɹi.sen.ti.tif]	[f.ti.tə.sem.pɹi.re]	"representative"
d.	[eŋ.kə.ɹeitʃ]	[tʃɹei.kə.en]	"encourage"

Take *foolish* in (5-12-a) as example. [liʃ] does not move as a whole in the reversal. Instead, [ʃ] directly exchanges its position with [fu] and [li], the same way as a syllable. This reversion strategy applies to the other words, producing a rather consistent split between fricative "codas" and their preceding syllables. Note that the syllabic [tʃ] in *encourage* (in (5-12-d)) is not a fricative. The syllabicity of singleton codas thus not only holds for fricatives, but also for the obstruents which are [+continuant]. At this point, the rules in (5-13) can be advocated for the postvocalic consonants in the normal-order speech.

[5] Coincidentally, the special status of fricative codas has also been reported in Wee (2006) with respect to the transliteration of English words in Hong Kong Cantonese.

(5-13) Rules for the syllabification of postvocalic obstruent

a. Syllabification of the obstruent C_2 in postvocalic C_1C_2 strings

$$\underset{[\text{-cont}]}{C}\ \underset{[\text{-son}]}{C} \rightarrow \underset{[\text{-cont}]}{C}.\ \underset{[\text{-son}]}{C}\ /\ V\_\_\#$$

b. Syllabification of postvocalic continuant obstruents

$$\begin{bmatrix}\text{-son}\\ \text{+cont}\end{bmatrix}C \rightarrow \begin{bmatrix}\text{-son}\\ \text{+cont}\end{bmatrix}.C\ /\ V\_\_\#$$

Legend: "cont" – continuant; "son" – sonorant.

(5-13-a) requires the C_2 in postvocalic C_1C_2 strings to be parsed as a syllabic obstruent. To capture this in OT, one needs a constraint that bans complex codas.

(5-14) ***CC]σ:**

Do not have complex codas (Kager 1999:97).

By placing *CC]σ and faithfulness constraints such as MAX above *OBSNUC, one gets a grammar that avoids coda clusters by obstruent syllabification. *OBSNUC should in turn outrank NOCODA, a constraint prohibiting all codas in general, in order to allow for singleton coda which is not a continuant obstruent. (5-15) demonstrates how this ranking selects the right output for *kept* (cf. 5-10-f).

(5-15) Evaluation tableau for *kept*

/kept/ "kept"	*CC]σ	MAX	*OBSNUC	NOCODA
kept	*!			**
☞ kep.t			*	*
ke.p.t			**!	
kep		*!		*

While most singleton codas are tolerated, continuant obstruents are not accepted in coda position, as is stated in (5-13-b). Such prohibition of continuant obstruent codas is not surprising considering the phonotactics of Cantonese (cf.

(4-7)) where the permitted coda consonants include only /p/, /t/, /k/, /m/, /n/, /ŋ/ and semivowels [j] and [w], none of which are continuant obstruents. A constraint banning continuant obstruent codas may thus be active in the I-grammar, arising from the speaker's L1.

(5-16) ***[-son,+cont $_{\text{CODA}}$]**[6]

Do not have continuant obstruent codas.

By putting *[-son,+cont $_{\text{CODA}}$] above *ObsNuc, one can get the correct results that *lapse* surfaces as [læp.s] while *lisp* as [li.s.p], demonstrated in (5-17).

(5-17) Evaluation tableaux for *lapse* and *lisp*

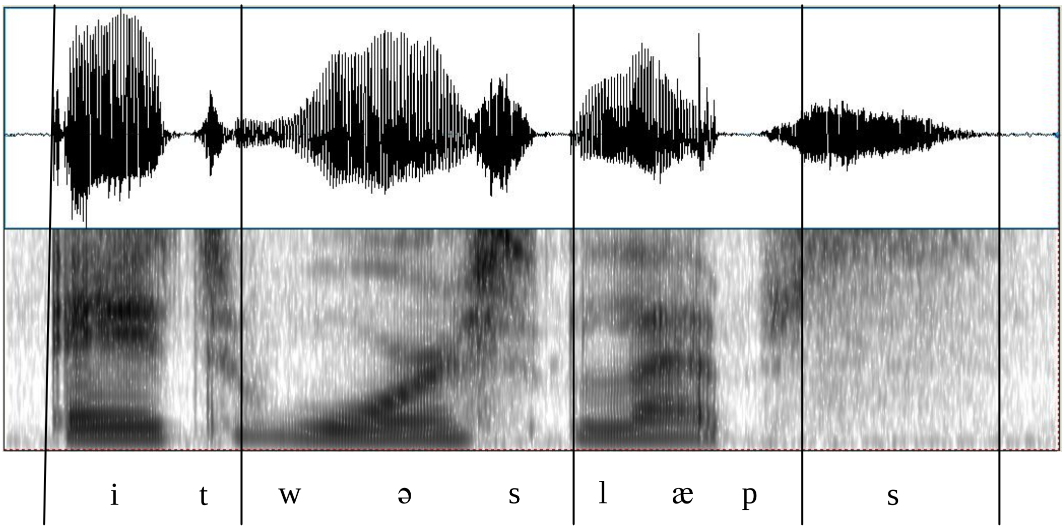
a. /læps/ "lapse"	*CC]σ	Max	*[-son,+cont $_{\text{CODA}}$]	*ObsNuc	NoCoda
læps	*!		*!		**
☞ læp.s				*	*
læ.p.s				**!	
læp		*!			*

b. /lisp/ "lisp"	*CC]σ	Max	*[-son,+cont $_{\text{CODA}}$]	*ObsNuc	NoCoda
lisp	*!		*!		**
lis.p			*!	*	*
☞ li.s.p				**	
lip		*!			*

The syllabicity of postvocalic continuant obstruents, as in [læp.s], also gains support from the phonetic evidence in the normal-order speech. As an illustration, consider the spectrogram in (5-18).

[6] One may question the universality of this constraint. The tremendous impacts of the L1 grammar on L2, however, are undeniable (cf. §2.2). It is fully possible for the phonotactic restrictions in L1 to be transferred to the L2 grammar. Moreover, since this dissertation only discusses L1 Cantonese speakers and will not compare their constraint rankings with the other L1 groups, the universality of *[-son,+cont $_{\text{CODA}}$] is not a serious issue.

(5-18) Spectrogram of the utterance “*it was lapse*”



(5-18) shows the spectrogram for the utterance “*it was lapse*”, with the tested word *lapse* appearing at the rightmost of the spectrogram. What is interesting is the time proportion of [læp] and [s] in the production of *lapse*, provided below.

(5-19) Time proportion of *lapse*

	[læp]	[s]
Duration	0.342s	0.296s
Proportion	53.6%	46.4%

[læp] and [s] each takes up roughly 1/2 of the total duration, though [læp] is slightly longer. Given that [læp] consists of three segments while the [s] part has only one, there is very likely a deliberate accentuation for the final [s]. This accentuation is also reflected in intensity, shown through the waveform in (5-18) where the final [s] is produced with relatively high amplitude. The accentuation is presumably the phonetic manifestation of the syllabic [s].

So far we have got two sets of constraint ranking. One is for onset; the other is for coda, shown below.

(5-20) <u>a. Onset constraint ranking</u>

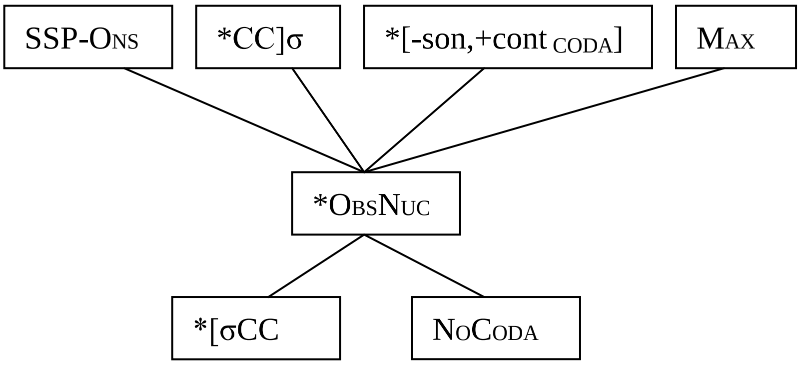
SSP-ONS >> *OBSNUC >> *[σCC

<u>b. Coda constraint ranking</u>

*CC]σ, MAX, *[-son,+cont $_{\text{CODA}}$] >> *OBSNUC >> NOCODA

To get the overall ranking of the speaker, one needs to combine (5-20-a) and (5-20-b). For monosyllabic words, the four top-ranked constraints in (5-20-a) and (5-20-b) (i.e. SSP-Ons, *CC]σ, Max, and *[-son,+cont$_{\text{COD}}$]) are never violated. They can be maintained at the top stratum of the whole ranking as there is no reason to put them below any constraint. The two bottom-ranked constraints *[σCC and NoCoda are both dominated by *ObsNuc. Since the two constraints do not conflict with one another in monosyllabic words, they can be put together as the lowest stratum. In sum, the overall ranking hierarchy of the current I-grammar is shown as (5-21) regarding monosyllabic words.[7]

(5-21) Ranking hierarchy of the Type I I-grammar



5.1.2 Type II: Obstruent syllabification in /s/-stop onsets and continuant obstruent codas

By ranking the constraints in (5-21) in different ways, one is able to get a number of hypothetically possible grammars, according to the factorial typology in OT. For example, demoting *CC]σ to the bottom stratum allows one to obtain a grammar which has no bias against coda clusters. This is exactly the case of the Type II I-grammar, observed in another informant (HK-F-24-01).

In the normal-order speech of this informant, the CC clusters in onset and in coda positions are preserved as they are, e.g. [bɹif] for *brief*, [lʌmp] for *lump*. This indicates that faithfulness constraints should outrank *[σCC and *CC]σ.

To check whether the adjacent consonants in the normal utterances are true

[7] Only the constraint ranking for monosyllabic words is deduced here. This is because the tethering effect of the E-grammar is tested through monosyllabic words in the language attitude test (see §5.3). The monosyllabic grammar in (5-21) has been sufficient for that purpose.

complex onsets or codas, the reverse language data are also examined. With regard to complex onsets, (5-22) presents how polysyllabic words which begin with a CC string are reversed.

(5-22) Reversal of polysyllabic words beginning with a CC string

	Normal	**Reverse**	
a.	[bɹi.tən]	[tən.bɹi]	"Britain"
b.	[klou.ʃə]	[ʃə.klou]	"closure"
c.	[pɹe.sə.dən.si]	[si.dən.sə.pɹe]	"presidency"
d.	[fɹeʃ.nəs]	[snəʃ.fɹeː]	"freshness"
e.	[sgei.tiŋ]	[tiŋ.geis]	"skating"
f.	[sbi.ɹi.tʃəl]	[tʃəl.ɹi.bis]	"spiritual"
g.	[stju.pə]	[pə.djus]	"stupid"

Separated by the dotted line, the reverse patterns in (5-22) can be divided into two types. From (5-22-a) to (5-22-d), the initial CC strings are kept intact and move together with their original syllables. The prevocalic [bɹ] in *Britain*, for example, is preserved as the onset of [bɹi] in both the normal and the reverse utterances. This is a clear indication that the initial adjacent consonants do form a constituent.

The reverse examples from (5-22-e) to (5-22-g), in contrast, show no support for the integrity of the prevocalic [s]-stop strings. In these examples, the [s]-stop sequence in the normal forms is split apart and the [s] moves like a syllable, the same way as the syllabic [s] in the Type I I-grammar. By regarding the [s] as syllable, one can then explain why *spiritual* is reversed [tʃəl.ɹi.bis] instead of [tʃəl.ɹi.sbi].

The syllabicity of the [s] is also consistent with the reversal of monosyllabic words, presented below.

(5-23) Reversal of monosyllabic words beginning with a sC or sCC string

	Normal	**Reverse**	
a.	[sbaː]	[baːs]	"spa "
b.	[sden]	[dens]	"stain"

c.	[sgeit]	[geis]	“skate”
d.	[sblit]	[blis]	“split”
e.	[sgɹiː]	[gɹiːs]	“scree”

In the above examples, the reversal demands simply the movement of the initial [s] to the rightmost of the whole word, which signifies a boundary between the [s] and the remaining word. On the basis of the polysyllabic and the monosyllabic data, the following rule holds for this I-grammar.

(5-24) [s] syllabification in prevocalic /s/-stop strings

$$s\ \underset{\begin{bmatrix}\text{-cont}\\ \text{-son}\end{bmatrix}}{C} \rightarrow s.\ \underset{\begin{bmatrix}\text{-cont}\\ \text{-son}\end{bmatrix}}{C} \quad / \ \#\_\_V$$

Same as the Type I I-grammar, (5-24) can be captured by the constraint ranking SSP-Ons >> *ObsNuc >> *[σCC. Under the ranking, obstruent syllabification will only occur to prevocalic /s/-stop strings but not to the other complex onsets.

Obstruent syllabification is also observed in coda position, and this applies even to singleton obstruent codas. To demonstrate this, (5-25) shows how polysyllabic words ending with a singleton obstruent are reversed.

(5-25) Reversal of polysyllabic words ending with a singleton obstruent

	Normal	**Reverse**	
a.	[ʌ.fɹeit]	[fɹeit.ʌ]	“afraid”
b.	[in.de.fə.neit]	[neit.fən.de.in]	“indefinite”
c.	[fe.bɹik]	[bɹik.feː]	“fabric”
d.	[ɹi.lei.ʃən.ʃip]	[ʃip.ʃən.lei.ɹi]	“relationship”
e.	[eŋ.gwiʃ]	[ʃgwə.en]	“anguish”
f.	[fu.liʃ]	[ʃli.fu]	“foolish”
g.	[sə.pous]	[spou.sə]	“suppose”
h.	[ʌ.pɹuf]	[f.pɹu.ʌ]	“approve”

Based on whether the word-final obstruents in the normal forms are preserved as a coda in the reverse forms, the data in (5-25) can be grouped into two types (shown through the dotted line). When the final obstruent is not continuant, as is the case of (5-25-a) to (5-25-d), it is kept as the coda of the original syllable. When the final obstruent is continuant, such as (5-25-e) to (5-25-h), it detaches from the original syllable and is treated as if another syllable. This indicates that the continuant obstruent "codas" in the normal speech are more likely consonantal syllables than true codas. The following rule in the Type I I-grammar hence applies here as well.

(5-26) Syllabification of postvocalic continuant obstruents

$$\underset{\begin{bmatrix}\text{-son}\\ \text{+cont}\end{bmatrix}}{\text{C}} \rightarrow \underset{\begin{bmatrix}\text{-son}\\ \text{+cont}\end{bmatrix}}{\text{.C}} \;/\; \text{V}\_\_\_\#$$

To explain (5-26), one needs the ranking *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> NoCoda. Faithfulness constraints such as Max should also be above *ObsNuc to make obstruent syllabification more preferable than deletion. Under the ranking, the continuant obstruents in CC "codas" should likewise be parsed as consonantal syllables. This is indeed the case, evidenced by the reversal of polysyllabic words containing a postvocalic CC string.

(5-27) Reversal of polysyllabic words containing a postvocalic CC string

	Normal	**Reverse**	
a.	[in.flekt]	[flekt.in]	"inflict"
b.	[eŋk.let]	[let.eŋk]	"anklet"
c.	[θeŋk.fəu]	[fəu.θeŋk]	"thankful"
d.	[dʌi.dʒest]	[ts.dʒe.dʌi]	"digest "
e.	[ai.tuns]	[stun.ai]	"i-Tunes"
f.	[si.kwəns]	[skwən.siː]	"sequence"

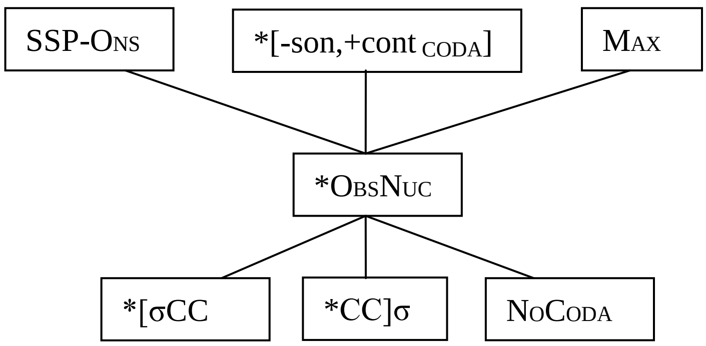
In (5-27), the postvocalic CC strings are either preserved as a whole or split apart in the reverse forms, depending on whether there is a fricative [s] in the strings. The postvocalic [kt] and [ŋk] in (5-27-a) to (5-27-c) do not contain a continuant obstruent and are kept as codas in both the normal and the reverse forms. The [st] and [ns] "codas" in (5-27-d) to (5-27-f) are broken apart in the reverse forms, and the [s] is always the segment that moves away like a syllable.[8] The contrast between [s] and the other non-fricative segments further confirms the ranking *[-son,+cont $_{\text{CODA}}$], Max >> *ObsNuc >> NoCoda. The preservation of the non-fricative-containing clusters also suggests the higher rank of *ObsNuc over *CC]σ. The current I-grammar should thus include the ranking *[-son,+cont $_{\text{CODA}}$], Max >> *ObsNuc >> *CC]σ, NoCoda.

Up to this point, two sets of constraint ranking have been obtained, shown below.

(5-28) <u>a. Onset constraint ranking</u>
SSP-Ons >> *ObsNuc >> *[σCC
<u>b. Coda constraint ranking</u>
*[-son,+cont $_{\text{CODA}}$], Max >> *ObsNuc >> *CC]σ, NoCoda

The two sub-rankings differ from the Type I I-grammar only in the position of *CC]σ. Based on the ranking of the Type I I-grammar (cf. (5-21)), one can get the overall ranking of this I-grammar by demoting *CC]σ, which is top-ranked in the Type I I-grammar. The final constraint ranking is shown as (5-29).

(5-29) Ranking hierarchy of the Type II I-grammar



[8] The final [t] in *digest* also moves away from [dʒe] in the reverse form. This is probably due to the preceding syllabic [s] which has divided [t] from [dʒe].

5.1.3 Type III: Deletion of obstruent-liquid onsets and homorganic coda clusters

The Type I and the Type II I-grammars avoid the unaccepted structures by obstruent syllabification. In an OT framework, this requires *OBSNUC to be ranked below MAX. By exchanging the relative rankings of *OBSNUC and MAX, one would get a third I-grammar type where the unwanted structures are avoided through consonant deletion. Such I-grammar is found in one Hong Kong informant (HK-M-23-01).

In terms of onset, there is a tendency for the informant to simplify obstruent-liquid onsets into singleton obstruent onsets. Some examples from the normal-order speech are as follows.

(5-30) Absence of the liquid in obstruent-liquid onsets

a.	[buːn]	"bloom"	f.	[koː]	"crawl"
b.	[bəːɹ]	"blur "	g.	[kou]	"crow"
c.	[bons]	"bronze"	h.	[fət]	"flirt"
d.	[kæ.ɹə.fai]	"clarify "	i.	[fuː]	"flu"
e.	[kous]	"close "	j.	[poms]	"prompts"

In the above examples, the C_1C_2 onsets are shortened as C_1, with the liquid C_2 absent. Such absence can either result from a deletion process such as (5-31) or from the non-existence of the C_2 in the underlying representations.

(5-31) Deletion of liquid in obstruent-liquid onsets

l / ɹ → ∅ / # [-son] ___ V

With a close look at the data, it is found that the process in (5-31) does exist. Take *flirt* as example. Three tokens have been produced for the word, and the three utterance attempts are as follows.

(5-32) Production attempts for *flirt*

a. Attempt 1: [flət]
b. Attempt 2: [fət]
c. Attempt 3: [fət]

The fact that *flirt* is pronounced as [flət] in the first attempt indicates that the C_2 /l/ is present in the underlying form. The [fət] in the second and the third attempts thus must involve a deletion of /l/. Since deletion is more common than cluster preservation, it is a phenomenon that should be accounted for in the description of this I-grammar.

In OT analysis, the deletion to onset clusters normally requires *[σCC to be ranked above MAX. The *[σCC >> MAX ranking alone, however, does not explain why the deleted segment is the liquid C_2, nor does it account for why deletion does not occur to the CC onsets such as follows.

(5-33) CC onsets where deletion never occurs

a.	[sgeit]	"skate"	d.	[sdeŋ]	"stain"
b.	[sbaː]	"spa"	e.	[sdæns]	"stance"
c.	[sbeə]	"spare"	f.	[sdaː]	"star"

To solve the problem, a promising way is a perception-based constraint proposed by Yip (1993), presented below.

(5-34) **MAX(Salient):**

Perceptually salient input segments must have output correspondents.

MAX(Salient) originates from the idea of Perceptual Scan (Silverman 1992) according to which foreign segments are not equally well-perceived by non-native ears, with the better detected ones more likely to be preserved in loanwords or in L2. Yip (1993) attributes perception to phonetic salience and advocates MAX(Salient) which demands only the preservation of perceptually salient segments while the omission of non-salient ones are tolerated. Based on phonetic reasons, Yip (1993) lists two types of non-salient consonants in English.

(5-35) Non-salient segments in English

a. The liquids in initial clusters;

b. Final post-consonantal stops.

The non-salience of the liquids in (5-35-a) is of particular relevance to the deletion cases discussed here, since it suggests that these liquids are not protected by MAX(Salient) whilst other onset consonants are. With the ranking MAX(Salient), *[σCC >> MAX, one is able to explicate why *close* surfaces as [kous] whereas *skate* as [skeit].

(5-36) Evaluation tableaux for *close* and *skate*

a. /klous/ "close"	MAX(Salient)	*[σCC	MAX
klous		*!	
☞ kous			*
lous	*!		*

b. /skeit/ "skate"	MAX(Salient)	*[σCC	MAX
☞ skeit		*	
seit	*		*!
keit	*		*!

With respect to coda, the majority of the CC codas are preserved in the present I-grammar. For examples, *ask* is produced as [ask], *kept* as [kept], *lisp* as [lisp]. The only exception is the word-final /nt/ and /nd/ where the final [t] and [d] are absent. Some examples are provided below.

(5-37) The absence of the /t/ and /d/ in word-final /nt/ and /nd/

a. [sek.mən] "segment"

b. [in.di.pen.dən] "independent"

c. [ʌn.də.sden] "understand"

d. [wut.len] "woodland"

Similar to the situation of onset clusters, one has to confirm if the absence of the [t] and [d] is caused by underlying forms or by a deletion process as (5-38).

(5-38) Deletion of /t/ and /d/ in word-final /nt/ and /nd/

t / d → ∅ / n __ #

To this end, an *–ing* suffix test has been made to the relevant words. Instances such as [ʌn.də.sden.diŋ] (for *understanding*) and [sek.mən.tiŋ] (for *segmenting*) prove the existence of the deletion process in (5-38).[9]

To account for the deletion, one needs to find out the factor that prevents the full mapping of /nt/ and /nd/. A possible solution is OCP[PLACE], defined as follows.

(5-39) OCP[PLACE]

Adjacent identical place features are prohibited (Frisch, Pierrehumbert & Broe 2004).

OCP[PLACE] is violated by adjacent segments which agree in the place of articulation, following the Obligatory Contour Principle (Leben 1973; McCarthy 1986) which states that adjacent identical segmental specifications are disfavored across languages. /nt/ and /nd/ all have coronal as their place of articulation, and hence will undergo deletion when OCP[PLACE] outranks MAX.

Quite naturally, one may doubt why the deletion triggered by OCP[PLACE] doe not apply to the other coronal-coronal codas such as /st/, and to homorganic labial and dorsal clusters such as /mp/ and /ŋk/. Nevertheless, when looking at the reverse language data and the productions of CCC codas in the normal speech, it is found that these coda clusters are indeed affected by OCP[PLACE].

In the reverse language, *digest* is realized as [dʒes.dʌi] though it is pronounced as [dʌi.dʒest] in the normal utterance. The omission of the [t] in the revere form at least suggests a tendency to simplify the [st] coda.

In terms of the productions of CCC codas in the normal-order speech, *dumped* and *instinct* are produced as [dʌmt] and [in.sdiŋt] respectively, with the /p/ and the /k/ elided. Interestingly, the omitted /p/ and /k/ share the same place of articulation with their preceding [m] and [ŋ]. The fact that /p/ and /k/ but not the final /t/ are deleted in the two words implies that the deletion is probably to avoid OCP[PLACE] violations.

Alternatively, one may attribute the deletion in *dumped* and *instinct* to the higher degree of markedness in CCC codas and claim that CCC codas are unaccepted in the I-grammar. This claim, nonetheless, would be refuted by the

[9] Wherever possible, this confirmation approach is adopted throughout the dissertation to check the deletion cases.

examples below.

(5-40) Preservation of CCC codas

a.	[aːsks]	"asks"	d.	[gespt]	"gasped"
b.	[elfs]	"elves"	e.	[gesps]	"gasps"
c.	[helpt]	"helped"	f.	[ʃelft]	"shelved"

Consonant deletion does not occur to the CCC codas in (5-40), which indicates that CCC codas are not a problem for the I-grammar. The deletion found in /mpt/ and /ŋkt/ clusters are therefore more likely to stem from OCP[PLACE].

Based on the evidence from the reverse language and from the CCC codas, OCP[PLACE] should play a role in the I-grammar.[10] When the constraints are ranked as MAX(Salient), OCP[PLACE] >> MAX >> *CC]σ, NOCODA, it is then possible to explain why deletion is found in /nt/ and /nd/ codas but not in non-homorganic coda clusters. Due to the non-salience of final post-consonantal stops (cf. (5-35-b)),[11] the ranking also rightly predicts the deleted segment in /nt/ and /nd/ and the preservation of /ns/ coda. (5-41) exemplifies how the correct outputs are selected in this ranking.

(5-41) Evaluation tableaux for *segment*, *hence* and *kept*[12]

a. /segmənt/ "segment"	MAX(Salient)	OCP[PLACE]	MAX	*CC]σ	NOCODA
sek.mənt		*!		*	*
☞ sek.mən			*		*
sek.mət	*!		*		*

b. /ʌituns/ "i-Tunes"	MAX(Salient)	OCP[PLACE]	MAX	*CC]σ	NOCODA
☞ ʌi.tuns		*		*	*
ʌi.tun	*		*!		*
ʌi.tus	*		*!		*

---

[10] Similarly, Chiu (2008) successfully uses OCP constraints explaining the simplification of coda clusters in HKE.

[11] As Silverman (1992:325) points out, final stops are often unreleased in English, which can render them less detectable to non-native ears.

[12] Readers may notice that the /g/ in *segmen*t surfaces as [k]. Such devoicing, as has been mentioned in §5.1.1, will be discussed in §5.4 given its independence with clusters.

c. /kept/ “kept”	Max(Salient)	OCP[place]	Max	*CC]σ	NoCoda
☞ kept				*	*
kep			*!		*
ket	*!		*		*

Taking together the findings in onset and coda, we have two constraint sub-rankings, shown in (5-42).

(5-42) a. Onset constraint ranking

Max(Salient), *[σCC >> Max

b. Coda constraint ranking

Max(Salient), OCP[place] >> Max >> *CC]σ, NoCoda

The two sub-rankings can be combined as (5-43), by transitivity of strict domination (Kager 1999:21).

(5-43) Max(Salient), OCP[place], *[σCC >> Max >> *CC]σ, NoCoda

The ranking in (5-43), however, would wrongly predict /st/ onset to surface as [s] or [t], with one of the consonants deleted. This is demonstrated in (5-44) through the word *star*.

(5-44) Evaluation tableau for *star*

/staː/ “star”	Max(Salient)	OCP	*[σCC	Max	*CC]σ	NoCoda
✓ sdaː		*!	*!			
💣 saː	*			*		
💣 taː	*			*		

Legend: 💣 - the wrongly selected candidates; ✓ - the actual output.

That [saː] or [taː] is selected is because Max(Salient) is in the same stratum with OCP[place] and *[σCC in the two sub-rankings in (5-42). In each of the sub-rankings, Max suffices to ensure the retention of /st/ onset as long as Max(Salient) is not lower than *[σCC or OCP[place]. After the combination of the two sub-rankings, *[σCC and OCP[place] will “gang up” and exert a greater power than Max(Salient). To prevent this, Max(Salient) should be ranked above *[σCC and OCP[PLACE], and the ranking in (5-43) should accordingly be adjusted as (5-45).

(5-45) MAX(Salient) >> OCP[PLACE], *[σCC >> MAX >> *CC]σ, NOCODA

To determine whether the remaining undeleted clusters are subject to the obstruent syllabification observed in the Type I and the Type II I-grammars, (5-46) first presents the reversal of the polysyllabic words which contain a CC onset.

(5-46) Reversal of polysyllabic words which contain a CC onset

	Normal	**Reverse**	
a.	[kon.stən.tin]	[tin.stən.kon]	"Constantine"
b.	[sdiu.bət]	[bət.sdiu]	"stupid"
c.	[sbi.ɹi.tʃou]	[tʃou.ɹi.sbi]	"spiritual"
d.	[sben.dit]	[di.sben]	"splendid "
e.	[sgei.tiŋ]	[tiŋ.sgei]	"skating"

In (5-46), the CC onsets in the normal forms (e.g. the [st] in *Constantine*, the [sb] in *spiritual*) are preserved in the reverse forms as well. Such preservation indicates that the prevocalic CC strings in the normal forms do form tight units.

Similar to onset, the integrity of CC codas is retained in the reverse utterances, exemplified in (5-47) through the reversal of polysyllabic words containing a CC coda.

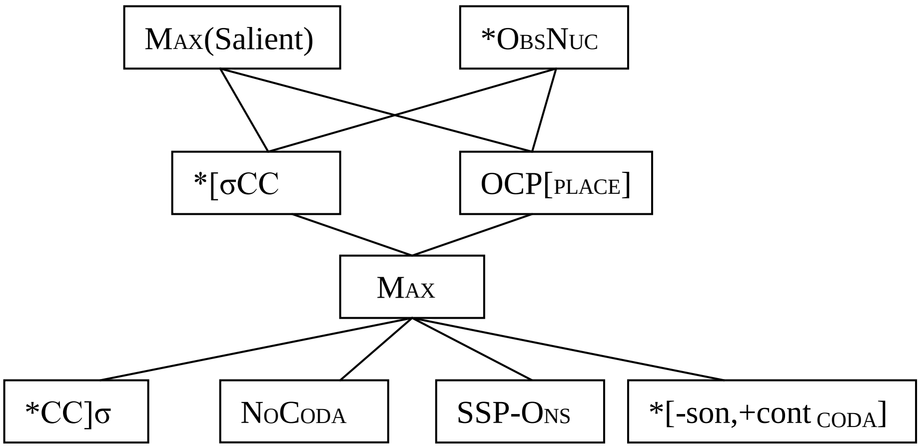
(5-47) Reversal of polysyllabic words which contain a CC coda

	Normal	**Reverse**	
a.	[sens.nəs]	[nəs.sens]	"senseless"
b.	[ʌi.tuns]	[tuns.ʌi]	"i-Tunes"
c	[in.flekt]	[flekt.in]	"inflict"
d.	[in.sdiŋt]	[sdiŋt.in]	"instinct"

Take *i-Tunes* as example. The fact that [tuns] is preserved as a syllable in both the normal and the reverse form indicates that the postvocalic [ns] forms the coda of the syllable, and hence obstruent syllabification does not take place.

In view of (5-46) and (5-47), one can confirm the dominance of *ObsNuc over *[σCC, *CC]σ, SSP-Ons, and *[-son,+cont$_{\text{CODA}}$]. Since *ObsNuc is never violated, it can be placed into the top stratum of the ranking in (5-45). SSP-Ons and *[-son,+cont$_{\text{CODA}}$], on the other hand, are always violated whenever needed and never show a higher power than any constraint, so they can be put at the bottom stratum. Ultimately, the ranking in (5-45) can be modified as (5-48), which captures the patterns in this I-grammar.

(5-48) Ranking hierarchy of the Type III I-grammar



5.1.4 Type IV: Obstruent syllabification in continuant obstruent codas

Compared with the first three types of I-grammar which have unacceptable clusters in both onset and coda positions, the Type IV I-grammar, observed in one Hong Kong informant (HK-M-31-01), only has difficulties with coda clusters.

In the normal-order speech, the I-grammar does not modify prevocalic CC strings, exemplified below.

(5-49) Preservation of prevocalic CC strings in the normal speech

a.	[bluːm]	"bloom"	d.	[skeit]	"skate"
b.	[fɹæŋk]	"frank"	e.	[spaː]	"spa"
c.	[gluː]	"glue"	f.	[stæns]	"stance"

Similarly, postvocalic CC strings are retained the same way as the following examples.

(5-50) Preservation of postvocalic CC strings in the normal speech

a.	[ent]	"ant"	d.	[lʌmp]	"lump"
b.	[iːst]	"east"	e.	[læps]	"lapse"
c.	[kept]	"kept "	f.	[oins]	"ounce"

The retention of pre- and postvocalic CC strings indicates the dominance of faithfulness constraints such as MAX and DEP over *[σCC and *CC]σ.

However, when looking at the reverse language data, it is found that the postvocalic CC strings in the normal speech do not necessarily form the coda of a syllable, because continuant obstruents are not allowed in coda position. To illustrate this, (5-51) presents how polysyllabic words which end with an obstruent are reversed.

(5-51) Reversal of polysyllabic words ending with a singleton obstruent

	Normal	**Reverse**	
a.	[hɒp.nɒp]	[nɒp.hɒp]	"hobnob"
b.	[in.vaː.led]	[led.faː.en]	"invalid"
c.	[faː.bɹek]	[bɹek.faː]	"fabric"
d.	[ɹi.lei.ʃən.ʃip]	[ʃip.ʃən.lei.ɹiː]	"relationship"
e.	[stjuu.bed]	[bʌd.stiu]	"stupid"
f.	[am.mjuːs]	[sɨ.mjuː.aː]	"amuse"
g.	[in.vjuːs]	[sɨ.fjuː.in]	"infuse"
h.	[a.pɹuːf]	[fu.pɹu.ap]	"approve"
i.	[eŋ.gleʃ]	[ʃit.glʌ.ʔeŋ]	"English"
j.	[eŋ.kəə.ɹeidʒ]	[dʒə.ɹei.kəɹ.eːn]	"encourage"

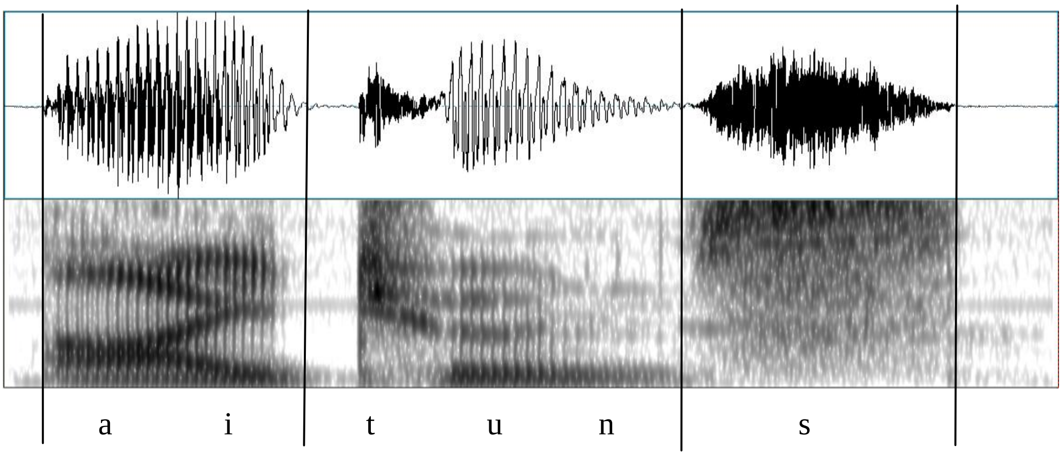
From (5-51-a) to (5-51-e), the normal forms end with a non-continuant obstruent; from (5-51-f) to (5-51-j), the last segment in the normal form is a continuant obstruent. The two sets of words exhibit different inversion patterns. When the final obstruent is a non-continuant, it is kept as the coda in both the normal and the reverse forms. This can be seen from the word *fabric* which is reversed as [bɹek.faː]. When the final obstruent is continuant, it is split from the original syllable and constitutes another syllable by itself. As an illustration, the final [s] in *amuse* forms the first syllable of the reverse form [sɨ.mjuː.aː]. The distinction between continuant and non-continuant obstruents suggests that, rather than being parsed as coda consonants, the postvocalic continuant obstruents in the normal forms are more likely consonantal syllables. The constraint ranking in (5-52) can thus be proposed for the I-grammar.

(5-52) *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> NoCoda

According to (5-52), the inclusion of continuant obstruent in CC codas should also be illegitimate. This is indeed reflected by the reversal of *i-Tunes*. The word is produced as [ai.tuns] in the normal utterance and as [sə.tun.ai] in the reverse. The word-final /ns/ is broken up in the reverse form, and the /s/ develops into another syllable [sə]. The independence of the /s/ relative to the /tun/ indicates that the final [s] in the normal form is a syllabic obstruent, and hence the phonological representation of the normal form is [ai.tun.s].

The [ai.tun.s] representation, in fact, also manifests itself phonetically, shown through the spectrogram below.

(5-53) Spectrogram of *i-Tunes*



(5-53) presents the articulation process of *i-Tunes*. Within the word, the time proportions of [ai], [tun] and [s] are as (5-54).

(5-54) Time proportion of *i-Tunes*

	[ai]	[tun]	[s]
Duration	0.231s	0.308s	0.241
Proportion	29.6%	39.5%	30.9%

In terms of duration, the word can generally be divided into three parts. The final [s] is close in length with the first syllable [ai] and its preceding [tun]. Also, the [s] is pronounced with a very high intensity (shown through the waveform in (5-53)). Considering that [s] is voiceless, the high intensity is very likely to be realized by an articulatory effort to enhance the sound. The phonetic evidence hence lends further support for the structure [ai.tun.s] and for the ranking *[-son,+cont CODA] >> *ObsNuc.

For all onset clusters in general and the other coda clusters which contain no continuant obstruent, obstruent syllabification does not occur. This is demonstrated below through the reversal of polysyllabic words.

(5-55) Retention of CC onsets and codas in polysyllabic reversal

a. Polysyllabic words with CC onsets

	Normal	Reverse	
i.	[bɹi.tin]	[tən.bɹit]	"Britain"
ii.	[klou.θiŋ]	[θiŋ.klʌu]	"clothing"
iii.	[skei.tiŋ]	[tiŋ.skei]	"skating "
iv.	[stjuː.bed]	[bʌd.stiu]	"stupid"

b. Polysyllabic words with CC codas

	Normal	Reverse	
i.	[æŋk.lat]	[lʌt.eŋk]	"anklet"
ii.	[in.di.pæn.dənt]	[dənt.pæn.diː.iːn]	"independent"
iii.	[saʔ.mənt]	[mint.sæːk]	"segment"
iv.	[θæŋk.fʌu]	[foː.θæŋk]	"thankful"

In (5-55-a), the onset clusters in the normal forms (e.g. the [bɹ] in *Britain*) are still kept as the onsets in the reversals. This holds for both obstruent-liquid onsets and /s/-initial onsets, indicating that *ObsNuc should outrank *[σCC and SSP-Ons.

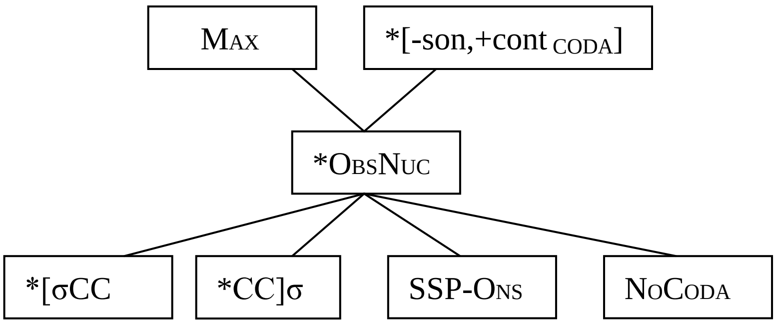
A similar scenario is found in (5-55-b) for the coda clusters containing no continuant obstruent. Take the *anklet* in (5-55-b-i) as example. The retention of the [ŋk] coda in both the normal form [æŋk.lat] and the reversal [lʌt.eŋk] suggests that coda clusters are acceptable in the I-grammar without resorting to obstruent syllabication. *CC]σ should thus be lower than *ObsNuc in the constraint ranking.

Based on the findings from (5-55), the *[-son,+cont$_{\text{CODA}}$] >> *ObsNuc >> NoCoda ranking in (5-52) can be expanded as follows.

(5-56) *[-son,+cont$_{\text{CODA}}$] >> *ObsNuc >> *[σCC, *CC]σ, SSP-Ons, NoCoda

Since consonant deletion does not occur (cf. (5-49) and (5-50)), Max is better placed into the top stratum in (5-56), and finally, we achieve the ranking in (5-57) for this I-grammar.

(5-57) Ranking hierarchy of the Type IV I-grammar



5.1.5 Type V: Deletion of homorganic coda clusters

The fifth type of I-grammar, exhibited by three informants (HK-F-26-01; HK-F-27-01; HK-M-20-01), disallows only homorganic coda clusters. These clusters are avoided by consonant deletions, expressible in OT through the lower rank of Max.

In the normal-order speech of the informants, CC onsets are faithfully preserved, e.g. *cliff* as [klif], *skate* as [skeit]. For the majority CC codas, cluster preservation is also the case, e.g. *stance* as [stæns], *kept* as [kept]. However, substantial deletions occur to the final stop in homorganic coda clusters. Across the three informants, some of the deletion examples are given as (5-58).

(5-58) Deletion of the final stop in homorganic coda clusters[13]

a. HK-M-20-01

i.	[dai.dʒeːs]	"digest"
ii.	[dis.bæn]	"disband"
iii.	[læn]	"lend"
iv.	[sæk.min]	"segment"
v.	[lʌm]	"lump"

b. HK-F-26-01

i.	[dʌi.dʒes]	"digest"
ii.	[dis.ben]	"disband"
iii.	[len]	"lend"
iv.	[seʔ.mən]	"segment"
v.	[lʌm]	"lump"

c. HK-F-27-01[14]

i.	[dis.bæn]	"disband"
ii.	[len]	"lend"
iii.	[seg.mən]	"segment"
iv.	[lʌm]	"lump"

Similar to the OCP-triggered deletion in the Type III I-grammar (cf. (5-37)), the deletion pattern in (5-58) be described by the rule in (5-59).

(5-59) Rule for the deletion of the final stop in homorganic coda clusters

$$\begin{bmatrix} \text{-son} \\ \text{-cont} \\ \alpha\ \text{Place} \end{bmatrix}^{\text{C}} \rightarrow \varnothing \ / \ \underset{[\alpha\ \text{Place}]}{\text{C}} \ \_\_ \ \#$$

[13] Following the *–ing* suffix test presented in §5.1.3, instances such as [dʌi.dʒes.tiŋ] (for *digesting*) prove that the absence of the final stops is true deletion.

[14] *Digest* (cf. (5-58-a-i) and (5-58-b-i)) is realized as [dai.dʒest] by the informant. Nonetheless, there is still evidence showing the simplification of the /st/ coda. The same word *digest*, for instance, is produced in the reverse language as [dʒes.dai], with the /t/ omitted.

To derive the effect of (5-59), one simply needs the ranking MAX(Salient) >> OCP[PLACE] >> MAX. The constraint OCP[PLACE] explains why homorganic clusters are simplified; MAX(Salient) tells why deletion occurs only to final stops, given the non-salience of final stops argued in Yip (1993) (cf. (5-35).

Since the other CC onsets and codas do not undergo deletion, MAX should in turn dominate *[σCC, *CC]σ, and NOCODA. The ranking in (5-60) thus operates in this type of I-grammar.

(5-60) MAX(Salient) >> OCP[PLACE] >> MAX >> *[σCC, *CC]σ, NOCODA

With a look at the reverse language data, it is found that *OBSNUC should also be placed high in the ranking. Evidence from the three speakers is provided below.

(5-61) Retention of CC onsets and CC codas in polysyllabic reversal

a. HK-M-20-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.tən]	[tən.bɹe]	"Britain"
	ii.	[klou.ʃəɹ]	[ʃəɹ.klʌu]	"closure"
	iii.	[skei.tiŋ]	[tiŋ.skei]	"skating"
CC coda	iv.	[iks.plaut]	[blaut.eks]	"explode"
	v.	[ai.tuːns]	[tjuns.ai]	"i-Tunes"
	vi.	[in.flekt]	[flekt.in]	"inflict"

b. HK-F-26-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.tən]	[təm.bɹi]	"Britain"
	ii.	[klou.ʃə]	[ʃə.klou]	"closure"
	iii.	[sgei.tiŋ]	[tiŋ.sgei]	"skating"
CC coda	iv.	[iks.blout]	[bloud.iks]	"explode"
	v.	[ʌi.tuns]	[tuns.ʌi]	"i-Tunes"
	vi.	[in.flekt]	[flekt.in]	"inflict"

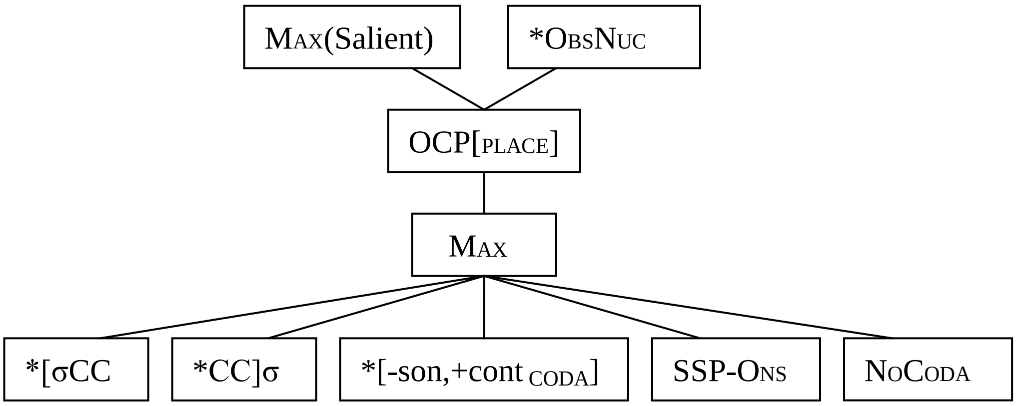
c. HK-F-27-01

		Normal	Reverse	
CC onset	i.	[bɹit.tən]	[tʌn.bɹiː]	"Britain"
	ii.	[klou.ʃə]	[ʃəː.klou]	"closure"
	iii.	[skei.tiŋ]	[tiŋ.skei]	"skating"
CC coda	iv.	[eks.ploud]	[bloud.eks]	"explode"
	v.	[ai.tuːns]	[tuːns.ai]	"i-Tunes"
	vi.	[in.flikt]	[flikt.in]	"inflict"

In (5-61), the reverse forms produced by the three speakers retain the CC onsets and codas in the normal utterances. Such retention of the complex syllable margins indicates that the pre- and postvocalic CC sequences in the normal speech do form true constituents. *ObsNuc hence is not violated and ranks above *[σCC, *CC]σ, SSP-Ons and *[-son,+cont $_{\text{CODA}}$].

Combined with the ranking in (5-60), the never-violated *ObsNuc can be put into the highest stratum in (5-60). Since there is no avoidance of /s/-stop onsets and continuant obstruent codas, SSP-Ons and *[-son,+cont $_{\text{CODA}}$] can be put to the bottom along with *[σCC and *CC]σ. The overall ranking hierarchy of this I-grammar type is ultimately displayed as (5-62).

(5-62) Ranking hierarchy of the Type V I-grammar



5.1.6 Type VI: Full retention of CC clusters

By placing Max, Max(Salient), and *ObsNuc on the top and the other constraints in (5-62) at a lower stratum, one would get a grammar where all types of CC clusters in the StdE are tolerated. This constrain ranking is the Type VI I-grammar, observed in three Hong Kong informants (HK-M-21-01; HK-M-22-01; HK-F-29-01).

When producing normal-order utterances, the three informants make no attempt to prevent CC clusters (e.g. *brief* is realized as [briːf]; *segment* as [seg.mənt]). The retention of consonant clusters suggests the high rank of faithfulness constraints such as MAX and MAX(Salient).

In the reverse language, evidence shows that the CC clusters in the normal speech are true complex syllable margins. Some examples are provided below.

(5-63) Retention of CC onsets and CC codas in polysyllabic reversal

a. HK-M-21-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.ʔən]	[ʔən.bɹi]	"Britain"
	ii.	[klou.ʃə]	[ʃə.klou]	"closure"
	iii..	[sgei.tiŋ]	[tiŋ.sgei]	"skating"
CC coda	iv.	[iks.hel]	[hel.eks]	"exhale"
	v.	[sens.les]	[les.sens]	"senseless"
	vi..	[θæŋk.fəu]	[fəu.θæŋk]	"thankful"

b. HK-M-22-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.tən]	[təm.bɹi]	"Britain"
	ii.	[klou.ʃə]	[ʃə.klou]	"closure"
	iii..	[sgei.tiŋ]	[tiŋ.sgei]	"skating"
CC coda	iv.	[eks.he.əl]	[hel.leks]	"exhale"
	v.	[sens.ləs]	[ləs.sens]	"senseless"
	vi..	[θæŋk.ful]	[ful.θæŋk]	"thankful"

c. HK-F-29-01

		Normal	Reverse	
CC onset	i.	[bɹe.ten]	[tʌn.bɹit]	"Britain"
	ii.	[klou.ʃəə]	[ʃəə.klou]	"closure"
	iii..	[skei.teŋ]	[teŋ.skei]	"spiritual"
CC coda	iv.	[eks.hee.ʌl]	[ou.hee.eks]	"exhale"
	v.	[sens.ləs]	[lʌs.sens]	"senseless"
	vi..	[θæŋk.fou]	[fou.θænk]	"thankful"

The CC onsets/codas in the normal forms also serve as the onsets/codas of the same syllable in the reverse renditions. This confirms that complex syllable margins are acceptable without turning to obstruent syllabification. *ObsNuc thus should also be ranked high.

By placing *ObsNuc, Max, and Max(Salient) over the markedness constraints that cause the break up of consonant clusters, the constrain ranking of the current I-grammar can be presented as (5-64). This ranking is also consistent with the StdE grammar.

(5-64) Ranking hierarchy of the Type VI I-grammar[15]

{*ObsNuc, Max, Max(Salient)}

|

{*[σCC, *CC]σ, SSP-Ons, *[-son,+cont $_{\text{CODA}}$], OCP[place], NoCoda}

5.1.7 Interim summary

Up to now, six types of I-grammar have been identified from the Hong Kong study, summarized as (5-65).

(5-65) I-grammar types in the Hong Kong study

Type I: Obstruent syllabification in /s/-stop onsets, CC codas and continuant obstruent codas

Number of speakers: 1

[15] The braces in (5-64) signal the constraints in the same stratum; the lines between the stratums indicate the dominance relationship.

Ranking hierarchy:

MAX, SSP-ONS, *CC]σ, *[-son,+cont $_{CODA}$] >> *OBSNUC >> *[σCC, NOCODA

Type II: Obstruent syllabification in /s/-stop onsets and continuant obstruent codas

Number of speakers: 1

Ranking hierarchy:

MAX, SSP-ONS, *[-son,+cont $_{CODA}$] >> *OBSNUC >> *[σCC, *CC]σ, NOCODA

Type III: Deletion of obstruent-liquid onsets and homorganic coda clusters

Number of speakers: 1

Ranking hierarchy:

MAX(Salient), *OBSNUC >> *[σCC, OCP[PLACE] >> MAX >> *CC]σ, SSP-ONS, *[-son,+cont $_{CODA}$], NOCODA

Type IV: Obstruent syllabification in continuant obstruent codas

Number of speakers: 1

Ranking hierarchy:

MAX, *[-son,+cont $_{CODA}$] >> *OBSNUC >> *[σCC, *CC]σ, SSP-ONS, NOCODA

Type V: Deletion of homorganic coda clusters

Number of speakers: 3

Ranking hierarchy:

MAX(Salient), *OBSNUC >> OCP[PLACE] >> MAX >> *[σCC, *CC]σ, SSP-ONS, *[-son,+cont$_{CODA}$], NOCODA

Type VI: Full retention of CC clusters (also the same as the StdE grammar)

Number of speakers: 3

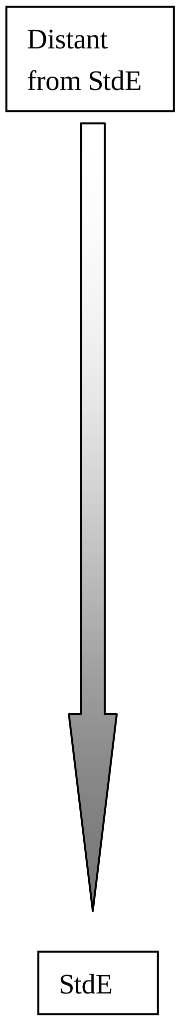
Ranking hierarchy:

MAX(Salient), MAX, *OBSNUC >> *[σCC, *CC]σ, SSP-ONS, *[-son,+cont $_{CODA}$], OCP[PLACE], NOCODA

The six I-grammar types employ different repairing strategies to complex syllable margins, expressible in OT as six distinct constraint rankings. The six rankings, however, are incomparable because they are unequal in the number of constraints.

To derive a learning path of the English learners in Hong Kong from the I-grammar types, the set of constraints in each ranking should be the same. For this purpose, one can add the constraints that have been used in some rankings but not in others to the ranking hierarchies in (5-65). The constraints that are never violated can be put into the existing top stratum, since there is no reason to lower rank them; the constraints that have been obviously violated can be placed at the existing bottom because they do not enforce the violation of the others. As such, the I-grammar types can be stated as (5-66) with the same set of constraints. The six rankings in (5-66) also represent a scale of L2 competence, with the Type I at the lowest end and the Type VI at the highest which equals the StdE.

(5-66) I-grammar ranking hierarchies in the Hong Kong study



Type I:

Max(Salient), Max, SSP-Ons, *CC]σ, *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> *[σCC, OCP[place], NoCoda

Type II:

Max(Salient), Max, SSP-Ons, *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> *[σCC, *CC]σ, OCP[place], NoCoda

Type III:

Max(Salient), *ObsNuc >> *[σCC, OCP[place] >> Max >> *CC]σ, SSP-Ons, *[-son,+cont $_{\text{CODA}}$], NoCoda

Type IV:

Max(Salient), Max, *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> *[σCC, *CC]σ, SSP-Ons, OCP[place], NoCoda

Type V:

Max(Salient), *ObsNuc >> OCP[place] >> Max >> *[σCC, *CC]σ, SSP-Ons, *[-son,+cont$_{\text{CODA}}$], NoCoda

Type VI:

Max(Salient), Max, *ObsNuc >> *[σCC, *CC]σ, SSP-Ons, *[-son,+cont $_{\text{CODA}}$], OCP[place], NoCoda

The increase of L2 competence from the Type I to the Type VI is reflected in two aspects. Firstly, the ranking distance with the StdE ranking (the Type VI) reduces from the Type I to the Type V, following the numeric measurement of ranking distance introduced in Appendix 1. By calculating the change in dominance relationship, the distances between the StdE ranking and the Types I, II, III, IV and V are as (5-67), which indicates an approximation towards the StdE ranking from the Type I to the Type VI.

(5-67) Numeric ranking distances with the StdE (the Type VI) ranking

	Rankings compared	**Numeric distance**
a.	Type I vs. Type VI	23
b.	Type II vs. Type VI	18
c.	Type III vs. Type VI	14
d.	Type IV vs. Type VI	11
e.	Type V vs. Type VI	9

Secondly, the advancement from the Type I to the Type VI is reflected by the scope of unaccepted structures in each I-grammar type, shown in (5-68).

(5-68) Unaccepted English structures in each I-grammar type

Type	**Unaccepted structures**
Type I	1. /s/-stop onsets; 2. CC codas; 3. Continuant obstruent codas.
Type II	1. /s/-stop onsets; 2. Continuant obstruent codas.
Type III	1. Obstruent-liquid onsets; 2. Homorganic coda clusters.
Type IV	Continuant obstruent codas.
Type V	Homorganic coda clusters.
Type VI	None.

In General, the scope of disallowed structures shrinks from the Type I to the Type VI. This is manifested both in the number and in the position of the structures: the number of the unaccepted cluster types reduces from three in the Type I to zero in the Type VI; the prohibited structures are found in both onset and coda positions in the Type I, II, and III, but are restricted to coda in Type IV and V.

With a closer look at (5-68), the progression from the Type I to the Type VI can be further divided into two branches which represent two specific learning routes. One of the routes is derived from the Types I, II, IV, and VI. It is describable by the Constraint Demotion Algorithm (CDA; §3.2) through the demotions of markedness constraints to a stratum lower than *OBSNUC, demonstrated as (5-69).

(5-69) The demotions of markedness constraints below *OBSNUC

Type I: MAX(Salient), MAX, *[-son,+cont $_{\text{CODA}}$], SSP-ONS, *CC]σ >>
*OBSNUC >>
*[σCC, OCP[PLACE], NOCODA

⇩ demoting *CC]σ

Type II: MAX(Salient), MAX, *[-son,+cont $_{\text{CODA}}$], SSP-ONS >>
*OBSNUC >>
<u>*CC]σ</u>, *[σCC, OCP[PLACE], NOCODA

⇩ demoting SSP-ONS

Type IV: MAX(Salient), MAX, *[-son,+cont $_{\text{CODA}}$] >>
*OBSNUC >>
<u>SSP-ONS</u>, *CC]σ, *[σCC, OCP[PLACE], NOCODA

⇩ demoting *[-son,+cont $_{\text{CODA}}$]

Type VI: MAX(Salient), MAX, *OBSNUC >>
<u>*[-son,+cont $_{\text{CODA}}$]</u>, SSP-ONS, *CC]σ, *[σCC, OCP[PLACE], NOCODA

(Legend: The underlines denote the newly demoted constraints.)

The other learning route can be identified from the Types III, V and VI, and is characterized by the demotions of markedness constraints below MAX.

(5-70) The demotions of markedness constraints below MAX

Type III: MAX(Salient), *OBSNUC >>
*[σCC, OCP[PLACE] >>
MAX >>

*CC]σ, SSP-ONS, *[-son,+cont$_{\text{CODA}}$], NOCODA

⇩ demoting *[σCC

Type V: MAX(Salient), *OBSNUC >>

OCP[PLACE] >>

MAX >>

*[σCC, *CC]σ, SSP-ONS, *[-son,+cont$_{\text{CODA}}$], NOCODA

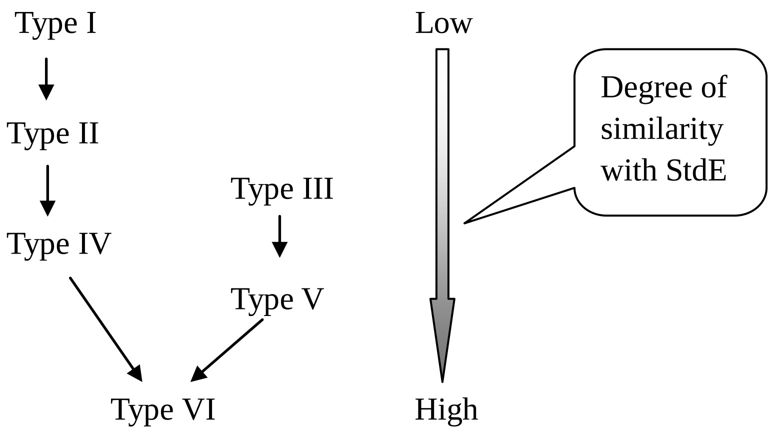
⇩ demoting OCP[PLACE]

Type VI: MAX(Salient), MAX, *OBSNUC >>

OCP[PLACE], *[σCC, *CC]σ, SSP-ONS, *[-son,+cont$_{\text{CODA}}$], NOCODA

Combining the two learning routes with (5-66), the trajectories through which the Hong Kong people acquire English consonant clusters can be summarized as (5-71). In (5-71), the levels of the six I-grammar types are also displayed through the scale on the right side.

(5-71) The developmental trajectories of the I-grammars



Besides revealing the paths of L2 development, the I-grammars also lay the foundation for one to discover the E-grammar of HKE, which leads us towards the next section.

5.2 The E-grammar of HKE

Given that an E-grammar is the grammar that generates "the totality of utterances that can be made" (i.e. the E-language) in a speech community (Chomsky 1986:19), the E-grammar of HKE is represented as a range of constraint rankings which covers the six I-grammar types in (5-66), shown as (5-72).

(5-72) A schematic representation of the E-grammar of HKE (E_{HK})

E_{HK}

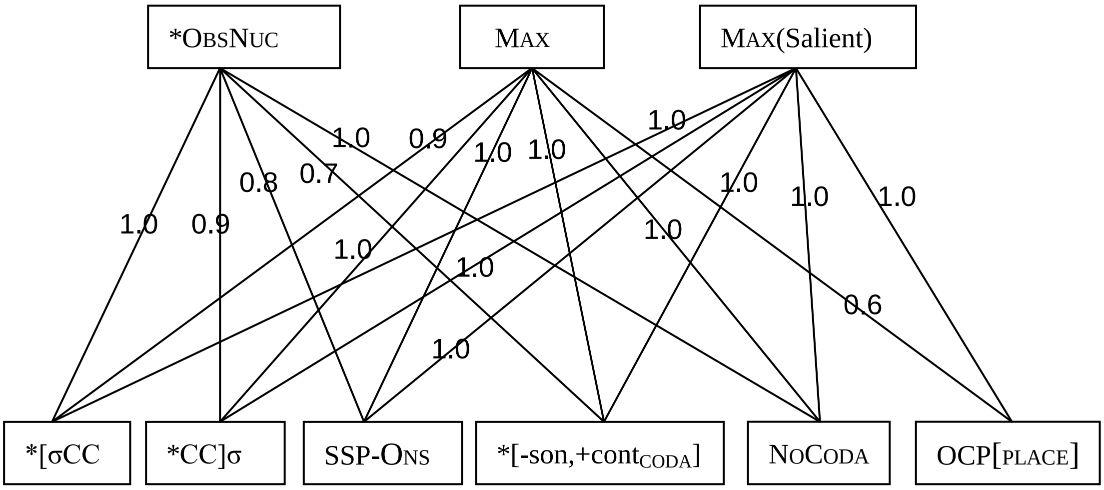
L1: ABCDEF>> GHI	*Type I*: ABCEG>> H>>DFI	*Type II*: ABCG>> H>>DEFI	*Type III*: AH>> DF>>G>> BCEI	*Type IV*: ACG>> H>>BDEFI	*Type V*: AH>>F>> G>>BCDEI	*Type VI* (*The StdE ranking*): AGH>> BCDEFI
	Cannot accept: 1./s/-stop onsets; 2.CC codas; 3.continuant obstruent codas. *Repairing strategy:* Syllabic obstruent.	*Cannot accept:* 1./s/-stop onsets; 2.continuant obstruent codas. *Repairing strategy:* Syllabic obstruent.	*Cannot accept:* 1.obstruent-liquid onsets; 2.homorganic coda clusters. *Repairing strategy:* Consonant deletions.	*Cannot accept:* 1.continuant obstruent codas. *Repairing strategy:* Syllabic obstruent.	*Cannot accept:* 1.homorganic coda clusters. *Repairing strategy:* Consonant deletions.	*Cannot accept:* None.

Legend:

A: MAX(Salient)	B: SSP-ONS	C: *[-son,+cont CODA]
D: *[σCC	E: *CC]σ	F: OCP[PLACE]
G: MAX	H: *OBSNUC	I: NOCODA

The range of the E-grammar (i.e. E_{HK}) begins with the Type I constraint ranking in (5-66) and ends with the Type VI ranking which equals the ranking of the StdE. The sequence of the grammar types within the range is determined according to the ranking distance with the StdE provided in (5-67). Beneath each ranking, the scope of the unaccepted structures and the repairing strategies through which these structures are avoided are also listed. In the convention of OT, this range can be described through a single Hasse diagram, shown in (5-73). The constraints that are placed above in the diagram have a higher rank. The number on each line indicates the frequency a certain constraint outranks another out of the 10 informants. The 0.8 on the line between *OBSNUC and SSP-ONS, for instance, means that *OBSNUC dominates SSP-ONS in eight I-grammars, whereas SSP-ONS ranks higher than *OBSNUC in the remaining two.

(5-73) Ranking hierarchy of the E-grammar of HKE



Judged from the scopes and the avoidance strategies in (5-72), it is clear that HKE does not preserve the consonant clusters in the StdE in all cases. To find out the major differences between HKE and the StdE, (5-74) lists, across the 10 individuals, the occurring frequencies of the constraint sub-rankings that trigger the break-up of consonant clusters.

(5-74) Frequencies of the rankings causing the break-up of CC clusters

Among the *ten* I-grammars, MAX(Salient) >> OCP[PLACE] >> MAX occurs *four* times;
*[-son,+cont$_{CODA}$] >> *OBSNUC occurs *thrice*;
SSP-ONS >> *OBSNUC occurs *twice*;

*CC]σ >> *OBSNUC occurs *once*;

MAX(Salient) >> *[σCC >> MAX occurs *once*.

Except the rankings in (5-74), consonant clusters are faithfully produced in all the other cases. Based on the frequency in (5-74), the patterns below hold for the E-grammar of HKE.

(5-75) Patterns of consonant clusters in the E-grammar of HKE

a. Consonant clusters are preserved in most conditions.

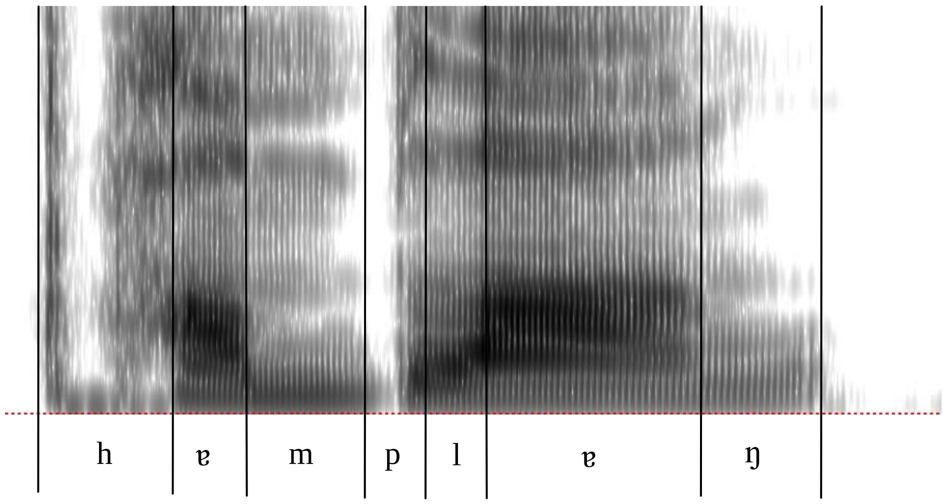
b. In terms of position, onset clusters (except s-/stop/ onsets) are more stable than coda clusters, since *[σCC is top-ranked only once whereas *[-son,+cont$_{CODA}$] and *CC]σ dominates *OBSNUC thrice and once respectively. Also, the MAX(Salient) >> OCP[PLACE] >> MAX ranking causes only the simplification of coda clusters.

c. In terms of cluster types, OCP-violated codas, codas containing continuant obstruents (violating *[-son,+cont$_{CODA}$]), and /s/-stop onsets (violating SSP-ONS) are least stable.

d. In terms of modification strategies, the unwanted structures are usually avoided by violating MAX or *OBSNUC. The violations of MAX lead to consonant deletions (mostly to homorganic coda clusters); the violations of *OBSNUC result in obstruent syllabification.

The consonant deletions and obstruent syllabification in (5-75-d) distinguish HKE from the StdE. The deletions to homorganic coda clusters corroborate the previous reports on HKE. In Chiu (2008), Deterding et al. (2008) and Setter et al. (2010), there is also a tendency in HKE to simplify codas such as /st/ and /nd/ into [s] and [n]. The obstruent syllabification, to my knowledge, is mentioned the first time for HKE. This modification strategy probably results from the L1 Cantonese where syllabic obstruents are also acceptable. In a study on the truncations in Malaysian Cantonese, Ong (2007) discovers that the underlying form /hɐm pɐŋ lɐŋ/ (for the expression “冚唪呤” which means “all”) surfaces as [hɐm.p.lɐŋ] in casual speech, with an obstruent syllable [p]. In Hong Kong Cantonese, the same underlying form is similarly realized as [hɐm.p.lɐŋ] in casual speech. As an illustration, (5-76) shows how a Hong Kong informant produced this expression.

(5-76) Spectrogram of [hɐm.p.lɐŋ] in Hong Kong Cantonese



In (5-76), there is no vowel following the [p], and the informant insisted that the expression has three syllables with the [p] as the second. The same judgment is found across different informants and hence confirms the low rank of *OBSNUC in Hong Kong Cantonese.

According to the ETT, at least one of the two modification strategies in HKE (consonant deletions and obstruent syllabification) should be attitudinally favored by the Hong Kong people. If such an inclination towards the E-grammar of HKE is the case, the stagnation of L2 acquisition would be of no surprise. Whether or not there is an alignment between HKE and the Hong Kong people's idealized grammar will be discussed in the following section.

5.3 The tethering effect of HKE

To test if the E-grammar of HKE has a force of attraction (i.e. the tether) on the Hong Kong people, a language attitude test was conducted to see 129 Hong Kong subjects' degree of preference for different constraint rankings as to consonant clusters, some of which are consistent to HKE and some others are not.

Take the word *rent* as example. The subjects heard four phonetic variants of the word (e.g. [ɹent], [ɹen], [ɹen.t] and [ɹen.tə]) and judged whether they liked the variants in a 5-point scale. Each variant involves the demotion of a corresponding constraint, shown as (5-77). The same procedure applied to several other words which cover the common consonant clusters in English (cf. §4.5.2 for a detailed introduction of the test).

(5-77) The constraint rankings represented by the phonetic variants

	Variants	**Ranking testing for**	**Remark**
a.	[ɹent]	MAX, DEP, *OBSNUC >> *CC	demoting *CC
b.	[ɹen]	*CC, DEP, *OBSNUC >> MAX	demoting MAX
c.	[ɹen.t][16]	*CC, DEP, MAX >> *OBSNUC	demoting *OBSNUC
d.	[ɹen.tə]	*CC, MAX, *OBSNUC >> DEP	demoting DEP

The test results are expressed through mean scores of each variant (min. = 1; max. = 5) (see Appendix 6-A for the full list of mean scores). To decide the constraint rankings preferred by the Hong Kong subjects, one needs to pick out the highest-rated phonetic variant for each word. The preferred variants also include those statistically similar to the highest-rated one, based on a Student-Newman-Keuls (SNK) test (p = 0.05).[17] As such, (5-78) lists, for each cluster type, the constraint(s) whose low rank is most preferred.

(5-78) Preferred constraint rankings for each cluster type

a. Preferred constraint rankings for onset clusters

i.	Onset tested (*word*)	[kl] *clear*	[kɹ] *cry*	[pɹ] *pray*	[fl] *fly*
	Constraint to be ranked low	*CC	*CC	*OBSNUC	*CC
ii.	Onset tested (*word*)	[fɹ] *frank*	[sk] *skate*	[st] *stay*	[sp] *speak*
	Constraint to be ranked low	*CC or DEP	*CC	*OBSNUC	*OBSNUC
iii.	Onset tested (*word*)	[sm] *smoke*	[skɹ] *scratch*	[spl] *split*	[spɹ] *spring*
	Constraint to be ranked low	*CC	*CC	*OBSNUC	*CC or *OBSNUC

[16] [ɹen.t] was produced by accentuating the final [t] and lengthening its interval with the preceding segment.
[17] The SNK test is used because it enables a comparison between each of the groups in a data set with more than three groups.

b. Preferred constraint rankings for coda clusters

i.	Coda tested (*word*)	[nt] *rent*	[mp] *camp*	[ŋk] *frank*	[ns] *hence*
	Constraint to be ranked low	*ObsNuc	*CC	*CC or *ObsNuc or Dep	*CC
ii.	Coda tested (*word*)	[nz] *bronze*	[ndʒ] *range*	[ntʃ] *inch*	[kt] *fact*
	Constraint to be ranked low	*CC or *ObsNuc	*CC	*CC	*CC
iii.	Coda tested (*word*)	[pt] *kept*	[st] *east*	[ft] *lift*	[sp] *lisp*
	Constraint to be ranked low	*ObsNuc	*CC	*CC	*CC
iv.	Coda tested (*word*)	[sk] *ask*	[ts] *eats*	[dz] *AIDS*	[ps] *lapse*
	Constraint to be ranked low	*CC	*CC	Max	*CC
v.	Coda tested (*word*)	[fs] *puffs*	[lt] *melt*	[lk] *milk*	[lp] *help*
	Constraint to be ranked low	*CC or *ObsNuc	*CC	*CC	*ObsNuc
vi.	Coda tested (*word*)	[ls] *else*	[lʃ] *Welsh*	[lf] *self*	[lv] *shelve*
	Constraint to be ranked low	*CC	*CC or *ObsNuc	*CC	*CC or *ObsNuc

To illustrate through the word *Welsh* (in 5-78-b-vi), the two low ranked constraints *CC and *ObsNuc indicate that the Hong Kong people equally prefer two variants: one (i.e. [welʃ]) requires the low rank of *CC; the other (i.e. [wel.ʃ]) lowest ranks *ObsNuc. Generalized from (5-78), the frequency each of the constraint rankings in (5-77) is preferred is shown as follows.

(5-79) The frequency each constraint ranking is most favorably perceived

Lowest ranked	*CC	Max	Dep	*ObsNuc
Onset position	66.7%	0%	8.3%	41.7%
Coda position	83.3%	4.2%	4.2%	33.3%

In general, the StdE ranking (*CC at the lowest stratum) is still the first option.

This is under the expectation of the ETT since consonant clusters are preserved in the E-grammar of HKE most of the time (cf. 5-75-a). Of interest are the following observations which may require an account from the ETT.

(5-80) Key observations in the language attitude test

a. The violation of *OBSNUC in /s/-stop onsets. Most of the onset clusters where the violation of *OBSNUC is preferred belong to /s/-stop onsets (33.3% out of 41.7%). In fact, for 66.7% of the /s/-stop onsets, the subjects incline towards the variant with a syllabic [s] (e.g. [s.pi:k] for *speak*). This is consistent to the SSP-ONS >> *OBSNUC ranking observed in HKE.

b. The violation of *OBSNUC in coda position. For 33.3% of the coda clusters, the speakers prefer the forms where the final consonant is produced as a syllabic obstruent (e.g. *rent* as [ɹen.t], *Welsh* as [wel.ʃ]). Given that three out of the 10 Hong Kong I-grammars produce syllabic obstruents in coda position, this observation forms another match with the E-grammar.

Both the above observations involve the low rank of *OBSNUC, a constraint that is placed low in HKE to satisfy SSP-ONS, *CC]σ or *[-son,+cont $_{\text{CODA}}$]. If the StdE ranking is the only target grammar for the Hong Kong subjects, their preference for the SSP-ONS, *CC]σ >> *OBSNUC ranking is not expected. Besides, for all clusters in general, the probability the subjects prefer the SSP-ONS, *CC]σ >> *OBSNUC ranking is 36.1%, which generally tallies with frequency *OBSNUC is violated in the E-language (30%; three out of the 10 I-languages violate *OBSNUC). The preferred grammar in the language attitude test is thus arguably a reflection of the E-grammar, both in terms of constraint ranking and in terms of distribution frequency. This is a finding in support of the ETT.

As another repairing strategy in HKE, the deletion to homorganic coda clusters is not high-scored in the attitude test, probably because, as Weinberger (1987) points out, consonant deletions can lead to the ambiguity at lexical level. For example, when the /d/ in /bend/ (for *bend*) is elided, the deleted form [ben] would be indistinguishable with another word *Ben*. The needs to retain communication intelligibility make the violation of *OBSNUC more acceptable than that of MAX.

In view of this finding, the following refinement can accordingly be made to the ETT: when the local E-grammar has more than one constraint ranking which differs from the standard varieties, the ranking that best ensures communication intelligibility will exert a greater tethering power. Further support for this refinement is from Sewell (2012) who also reports Hong Kong students' acceptance of the HKE accents. This acceptance, however, applies only to the HKE accents which do not reduce intelligibility.

In sum, the English learners in Hong Kong, without affecting intelligibility, have two target grammars, presented below.

(5-81) Target grammars for the English learners in Hong Kong

(a) MAX, DEP, *OBSNUC >> *[σCC, *CC]σ, SSP-ONS

(b) MAX, DEP, SSP-ONS, *CC]σ >> *[σCC, *OBSNUC

(5-81-a) agrees with the StdE ranking. (5-81-b) falls in the E-grammar of HKE and leads to obstruent syllabification. The acceptance of (5-81-b) validates the prediction of the ETT and provides the attitudinal explanation for why the violations of *OBSNUC persist in the English of the Hong Kong people (cf. the "bottleneck problem" in §1.1).

5.4 Evidence outside cluster acquisition

Besides cluster acquisition, there are additional findings in the Hong Kong study supporting the ETT. A noticeable case is the devoicing of word-final obstruents, which presents another alignment between the Hong Kong people's attitudinally desired grammar and the actual E-grammar of HKE.

As is mentioned in §5.1.1, the speech of the Hong Kong informants is characterized by final obstruent devoicing. In the devoicing cases, word-final voiced obstruents are neutralized towards their voiceless counterparts, and minimal pairs such as *lend~lent* and *lunch~lunge* become indistinguishable[18] (see Peng & Ann (2004) for a similar report on the final devoicing in HKE). (5-82) on

[18] To ascertain whether the voiceless obstruents at surface level are true devoicing or simply because they are voiceless in the underlying representations (cf. the RP Fallacy; Mohanan 1992), an *–ing* suffix test has also been conducted. For example, if the word *range* is realized as [ɹæntʃ] and *ranging* as [ɹæn.dʒiŋ], there is true devoicing. However, when *ranging* surfaces as [ɹæn.tʃiŋ], the devoicing process does not exist. Throughout this dissertation, the devoicing cases refer only to the true devoicing in the former situation, based on the results of the *–ing* suffix test.

page 101 summarizes, across the 10 Hong Kong informants in the production test, whether or not the neutralization of voicing contrast occurs to final obstruents.

In (5-82), final devoicing has been observed in nine out of the 10 informants. Among the nine informants, six have devoiced both word-final stops and final fricatives/affricates, as word-final voiced segments are realized the same way as their voiceless counterparts in the devoicing cases (voiced stops as voiceless aspirated; voiced fricatives/affricates as voiceless). The devoicing phenomena are more common for fricatives and affricates than for stops,[19] reflected in the other three speakers who only neutralize the voicing contrast for final fricatives and affricates.

The neutralization of voicing contrast not only appears in coda clusters, but also in simple obstruent codas. For example, the word *bled* is produced as [blet^h], *age* as [eitʃ]. This indicates that devoicing is not directly due to clusters, but prompted by a general tendency to prevent voiced final obstruents. In OT, such a tendency can be stated through the constraint in (5-83).

(5-83) **VOICED OBSTRUENT PROHIBITION (VOP)**
No obstruent must be voiced (Ito & Mester 1998; Kager 1999).

Generalized from the cross-linguistic trend against voiced obstruents, VOICED OBSTRUENT PROHIBITION (VOP) is utilized in Kager (1999) to capture the final devoicing in Dutch.[20] It gives one violation mark for each voiced obstruent and no mark for voiceless ones. When VOP outranks IDENT[Voice], whose definition is given below, voiced obstruents will be replaced by voiceless ones.

(5-84) **IDENT[Voice]**
The specification for the feature [voice] of an input segment must be preserved in its output correspondent (Kager 1999:14).

---

[19] Final stops are less prone to neutralization, probably because the contrast for final stops can be maintained either through voicing or aspiration, while the contrast for fricatives can only be realized through voicing.

[20] Lombardi (1999) similarly proposes a constraint that bans voiced obstruents. As is pointed out in Vaux & Samuels (2006), the unmarkedness of voiceless obstruents, particularly of voiceless aspirated stops, gains support from a wide range of areas, including language acquisition, articulation, speech perception and language change.

(5-82) Final obstruent devoicing across the 10 Hong Kong informants

Informant	Final obstruent devoicing occurs or not	If devoiced, final voiced stops surface as:	Final voiceless stops surface as:	If devoiced, final voiced fricatives and affricates surface as:	Final voiceless fricatives and affricates surface as:
HK-F-23-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
HK-F-26-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
HK-F-27-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
HK-F-29-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
HK-M-22-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
HK-M-23-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
HK-F-24-01	Yes for fricatives and affricates	N/A	Voiceless aspirated	Voiceless	Voiceless
HK-M-20-01	Yes for fricatives and affricates	N/A	Voiceless aspirated	Voiceless	Voiceless
HK-M-21-01	Yes for fricatives and affricates	N/A	Voiceless aspirated	Voiceless	Voiceless
HK-M-31-01	No	N/A	Voiceless aspirated	N/A	Voiceless

Since voicing contrast is preserved for onset obstruents, VOP must in turn be dominated by a positional faithfulness constraint as follows.

(5-85) **IDENT[Voice,ONS]**

Output segments in onset position preserve values of [voice] for input correspondents (Kager 1999:340).

With the ranking IDENT[Voice,ONS] >> VOP >> IDENT[Voice], one can then explain why devoicing occurs to final obstruents but not to onset obstruents.

Alert readers may recall that final obstruents are not codas in some of the HKE I-grammars (the I-grammars of Type I, Type II, and Type IV in (5-72)), since postvocalic obstruents can be parsed as consonantal syllables (e.g. [len.t] for *lend;* [ei.tʃ] for *age*). For these I-grammars, final devoicing is not the devoicing of coda segments but of syllabic obstruents. This, nonetheless, is not a crucial issue for the ranking IDENT[Voice,ONS] >> VOP >> IDENT[Voice], because whether or not final obstruents are codas will not affect the outcome of the OT evaluation, exemplified in (5-86).

(5-86) Evaluation tableau for I-grammars disallowing coda obstruents

/lend/ “lend”	IDENT[Voice,ONS]	VOP	IDENT[Voice]
len.d		*!	
☞ len.t			*

IDENT[Voice,ONS] protects only the voiced obstruents at onset position but not syllabic obstruents. Under the effect of VOP, voiced syllabic obstruents will be devoiced as well. The IDENT[Voice,ONS] >> VOP >> IDENT[Voice] ranking thus holds for all Hong Kong speakers who make final devoicing.

Given the popularity of final devoicing shown in (5-82), the two constraint rankings in (5-87) coexist the E-grammar of HKE.

(5-87) Constraint rankings in E-grammar of HKE

a. The StdE ranking which preserves final voicing contrast
IDENT[Voice,ONS], IDENT[Voice] >> VOP

b. The ranking which leads to final obstruent devoicing
IDENT[Voice,ONS] >> VOP >> IDENT[Voice]

As is predicted by the ETT, the two rankings would have a force of attraction on the English speakers in Hong Kong. Particularly, the Hong Kong people are expected to show acceptance towards (5-87-b) which produces final devoicing. To check whether such acceptance is the case, the language attitude test in §5.3 includes 10 tested words which examine the 129 Hong Kong subjects' degree of preference for final devoicing (see Appendix 5 for the list of stimuli). Take the word *bulb* as example. The subjects heard two phonetic variants of the word and judged whether they like the variants in a 5-point scale. One of the variants is [bʌlb] and the other is [bʌlp^h]. The former corresponds to the StdE ranking in (5-87-a) and the latter to (5-87-b).

Across the tested words, the frequencies the devoiced variants and the non-devoiced variants are favored are summarized as (5-88). Same as §5.3, the percentages in (5-88) count both the highest-rated variants and those statistically similar to the highest-rated ones, based on a one-way ANOVA test (p = 0.05)[34] (for the list of mean scores, see Appendix 6-B).

(5-88) The frequency each variant is preferred

Non-devoiced forms (corresponds to 5-87-a)	50%
Devoiced forms (corresponds to 5-87-b)	80%

It turns out that the likelihood the devoiced forms are preferred (80%) is even higher than the non-devoiced forms (50%). This means that, for the Hong Kong people, the constraint raking which produces final devoicing (i.e. 5-87-b) is more acceptable than the StdE ranking in (5-87-a). One may probably attribute this to the subjects' lack of knowledge of final voicing contrast. The lack of knowledge, however, entails that the stimuli with or without final voicing will sound the same to the subjects and their ratings will be fairly close. The fact that the non-devoiced forms receive 50% and the devoiced forms receive 80% suggests that this is not likely the case and the subjects do differentiate the two types of stimuli. Such acceptability of a "non-standard" grammar would form a challenge to any view that considers the StdE as the only source of input, but can be easily explained by

[34] The SNK test is not employed in this case because it requires more than two groups of data.

the attraction (i.e. the E-tether) from the ranking in (5-87-b). The final devoicing in HKE thus provides another case supporting the ETT.

5.5 Summary

This chapter validates the applicability of the ETT through the acquisition of English consonant clusters and final voicing contrast by the Hong Kong people. Such applicability is reflected in the alignment between the Hong Kong people's attitudinally favored grammar and the actual E-grammar of HKE.

From the I-grammars of 10 typical English speakers in Hong Kong, the E-grammar of HKE is generalized with respect to consonant clusters. In the E-grammar, English consonant clusters are not always tolerated, and the disallowed clusters can be prevented by parsing obstruents as consonantal syllables. The word *inch*, for instance, may surface as [in.tʃ]. Described in OT, the obstruent syllabification requires *ObsNuc to be ranked below the markedness constraints that demand the break-up of consonant clusters (e.g. *CC]σ, SSP-Ons). As a prominent property of the E-grammar, the low rank of *ObsNuc is attitudinally accepted by the Hong Kong people, drawing evidence from a language attitude test exploring 129 Hong Kong subjects' preferred constraint ranking. The consistency between a community's desired grammar and the local E-grammar is precisely what the ETT predicts.

The Hong Kong people's inclination towards the local E-grammar is also observed in the acquisition of final voicing contrast. In the E-language of HKE, the devoicing of word-final obstruents extensively occurs, expressible through the constraint ranking Ident[Voice,Ons] >> VOP >> Ident[Voice]. This ranking is likewise highly preferred by the Hong Kong subjects in the language attitude test (in fact even more preferable than the StdE ranking), and hence forms another case backing the ETT.

Chapter Six

Empirical Validation: The Guangzhou Study

To further test the applicability of the ETT in different language environments, this chapter discusses how well the theory captures the acquisition of English consonant clusters by the native Cantonese speakers in Guangzhou. Following the experiment paradigm in the Hong Kong study, this chapter looks into whether, as is predicted by the ETT, the Guangzhou people identify with the way consonant clusters are produced in Guangzhou English (GZE), the E-language prevalent in the speakers' language environment.[1]

§6.1 describes the I-grammars of 10 GZE speakers regarding consonant clusters, which enables the establishment of the E-grammar in §6.2. §6.3 illuminates whether the E-grammar of GZE is attitudinally accepted by the Guangzhou people, drawing evidence from a language attitude test. As additional proof, §6.4 discusses final obstruent devoicing in GZE in relation to the ETT. The chapter ends with a summary in §6.5.

6.1 Typology of I-grammars

As the foundation of discovering the E-grammar, this section describes the I-grammars of 10 Guangzhou people with respect to English consonant clusters. Based on the speakers' productions of consonant clusters (cf. §4.5.1 for the source of the data), five types of I-grammars have been observed across the 10 individuals, presented below.

(6-1) Typology of I-grammars

<u>Type I</u>

[1] Whether or not Guangzhou English can be counted as a recognizable and stabilized variety may still be in question. Bruthiaux (2003:168), for example, argues that the varieties in the Expanding Circle have to meet a series of requirements such as speaker proficiency and domains of use. This however is not critical here, because, no matter whether Guangzhou English can be regarded as a variety, it is widely heard and spoken in the Guangzhou people's learning environment and provides input. As Kirkpatrick (2007:192) points out, the local model of English has already gained a *de facto* position in classrooms in many parts of China since "local Chinese English language teachers have no option but to teach the model they themselves have learned". It is hence reasonable to believe GZE to be the source of the E-tether for the Guangzhou people.

Number of speakers: 1

Description: Obstruent syllabification in CC onsets and all obstruent codas; deletion of coronal-coronal codas.

Type II

Number of speakers: 2

Description: Obstruent syllabification in /s/-stop onsets and all obstruent codas.

Type III

Number of speakers: 1

Description: Obstruent syllabification in /s/-stop onsets and continuant obstruent codas.

Type IV

Number of speakers: 3

Description: Deletion of coronal-coronal codas.

Type V

Number of speakers: 3

Description: Faithful preservation of consonant clusters.

The subsections from §6.1.1 to §6.1.5 demonstrate how each of the above I-grammar types is deduced and expressed in OT, leading to §6.1.6 which summarizes the identified I-grammar constraint rankings.

6.1.1 Type I: Obstruent syllabification with deletion of coronal-coronal codas

The Type I I-grammar in (6-1) is found in one Guangzhou speaker (GZ-M-19-01). Using the approach of analysis in the Hong Kong study, the constraint ranking of the I-grammar is dependent on (i) the how the speaker produces consonant clusters in the *normal-order speech*, and (ii) the *reverse utterances* (cf. §4.4) of the words containing consonant clusters.

In the normal-order speech, the majority of CC clusters are faithfully realized (see Appendix 9 for the list of transcriptions). One exception is the devoicing of word-final continuant obstruents, e.g. *range* is realized as [ɹeintʃ], *shelve* as [ʃelf].[2] Similar to the Hong Kong study, final obstruent devoicing takes place extensively among the Guangzhou speakers and is not caused by clusters, since words such as *age* and *gave* also undergo final devoicing (e.g. *age* as [eitʃ], *gave* as [geif]). Final devoicing will thus be discussed separately in §6.4 as another example testing the ETT.

Another pattern that emerges from the data is the deletion of the /t/ or /d/ in word-final /nt/ and /nd/. Some examples are provided below.

(6-2) Deletion of the /t/ or /d/ in word-final /nt/ and /nd/[3]

a.	[sek.mən]	"segment"
b.	[in.di.pen.dən]	"independent"
c.	[dis.ben]	"disband"
d.	[ɹe.kə.men]	"recommend"

To explain why deletion occurs to the examples above but not to the other clusters, one may need a constraint as follows.

(6-3) **OCP[COR]:**
No adjacent coronals (Pater & Coetzee 2005:90).

OCP[COR] is a specific instantiation of the OCP[PLACE] introduced in (5-39).[4] When OCP[COR] outranks MAX, coronal-coronal sequences like /nt/ and /nd/ will undergo deletion. To further account for why the final /t/ and /d/ are the deleted segments, the faithfulness constraint MAX(Salient) (cf. (5-34)) comes into play, since the final /t/ and /d/ fall outside the protection of MAX(Salient) while other coronal segments do not. With the ranking MAX(Salient), OCP[COR] >> MAX, one captures the deletion shown in (6-2). This can be demonstrated through (6-4).

[2] Instances such as [ɹein.dʒiŋ] (for *ranging*), [ʃel.viŋ] (for *shelving*), and [in.kə.ɹi.dʒiŋ] (for *encouraging*) indicate that the devoicing phenomenon does exist.

[3] Same as the Hong Kong study, an *–ing* suffix test (cf. §5.1.3) has been implemented and confirmed that the absent /t/ and /d/ present in the underlying forms.

[4] There may be better solutions than OCP[COR] to the deletion case discussed here, as coronal is not among the most marked places of articulation. OCP[COR] is used because it provides a way to explain the observed phenomenon and because it will not affect the results of the test to the ETT.

(6-4) Evaluation tableau for *recommend*

/ɹekəmend/ "recommend"	MAX(Salient)	OCP[COR]	MAX
ɹe.kə.mend		*!	
☞ ɹe.kə.men			*
ɹe.kə.med	*!		*

Judged from the normal-order speech, this I-grammar forbids only postvocalic coronal-coronal combinations whereas the other CC clusters are allowed. To confirm if the adjacent consonants in the normal utterances are true complex onsets or codas, the productions of the relevant words in the reverse language are also analyzed. Regarding complex onsets, (6-5) first presents how polysyllabic words with a complex onset are reversed.

(6-5) Reversal of polysyllabic words containing a complex onset

	Normal	**Reverse**	
a.	[klou.ʃə]	[ʃə.louk]	"closure"
b.	[ɹi.kɹu.tə]	[tə.ɹu.kə.ɹi]	"recruiter"
c.	[im.ploː]	[lop.im]	"implore"
d.	[ə.pɹuːf]	[fɹu.pə.ə]	"approve"
e.	[sgei.tiŋ]	[tiŋ.geis]	"skating"
f.	[sbi.ɹi.tʃəl]	[tʃəl.ɹi.pis]	"spiritual"

In the above examples, the C_1C_2 "onsets" in the normal forms are divided in the reverse forms into a simple onset C_2 and another independent segment C_1, resembling the obstruent syllabification observed in the Hong Kong study (cf. §5.1.1, §5.1.2, and §5.1.4). Take the word *closure* in (6-5-a) as example. If /kl/ is viewed by the I-grammar as an onset cluster, one would expect the word to be reversed as [ʃə.klou] rather than the actual reverse form [ʃə.louk]. The mobility of the C_1 relative to the C_2 indicates that the C_1C_2 "onsets" in the normal utterances are not phonological constituents, but consist of a singleton onset C_2 and a syllabic obstruent C_1, describable as the rule in (6-6).

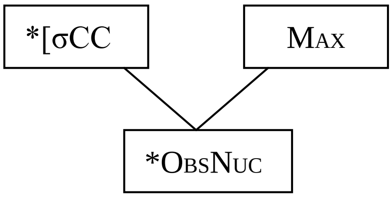
(6-6) Syllabification of the C_1 in prevocalic C_1C_2 strings

CC → C. C / # ___ V

Legend: "." – syllable boundary; "#" – word boundary.

In OT, the rule in (6-6) can be attributed to a constraint banning complex onsets, such as *[σCC. When *[σCC ranks above *ObsNuc (definition provided in (5-6)), the effect in (6-6) is derivable. Also, the fact that complex onsets are avoided through obstruent syllabification instead of other repairing strategies suggests that faithfulness constraints such as Max should outrank *ObsNuc. We thus arrive at the ranking in (6-7) for the onsets in this I-language. As an illustration, (6-8) shows how this ranking selects the correct output for the word *closure*.

(6-7) Constraint ranking for the onsets in the Type I I-language



(6-8) Evaluation tableau for *closure*

/klouʃə/ "closure"	*[σCC	Max	*ObsNuc
klou.ʃə	*!		
☞ k.lou.ʃə			*
kou.ʃə		*!	

With respect to coda clusters, the reverse language data show that obstruent syllabification also occurs in postvocalic position. To illustrate this, (6-9) presents how polysyllabic words containing a CC coda are reversed.

(6-9) Reversal of polysyllabic words containing a postvocalic CC string

	Normal	**Reverse**	
a.	[dʌi.dʒest]	[tsdʒe.dʌi]	"digest"
b.	[ʌi.tyns]	[styn.ʌi]	"i-Tunes"
c.	[si.kwəns]	[skwən.siː]	"sequence"
d.	[fæŋk.fəu]	[fəuk.fæn]	"thankful"

In (6-9), the "CC codas" in the normal utterances are broken up in the reverse forms. Such break-up follows a manner – any obstruent member in the CC strings (e.g. the [s] and [t] in *digest* (see 6-9-a); the [s] in *i-Tunes* (see 6-9-b)) stands out and interchanges with the other syllables. In this pattern, the obstruents in coda position are treated as syllables. The postvocalic CC strings in the normal forms hence are unlikely true codas.

Further evidence for the syllabicity of postvocalic obstruents comes from the reversal of monosyllabic words, shown below.

(6-10) Reversal of monosyllabic word which end with a CC string

	Normal	**Reverse**			**Normal**	**Reverse**	
a.	[kops]	[spkoː]	"corpse"	f.	[ɒks]	[sk.ɒ]	"ox"
b.	[aːsk]	[ks.aː]	"ask"	g.	[lift]	[tfliː]	"lift"
c.	[pʌfs]	[sfpʌ]	"puffs"	h.	[lʌmp]	[plʌm]	"lump"
d.	[ɹeintʃ]	[tʃɹein]	"range"	i.	[aːns]	[s.aːn]	"ounce"
e.	[melt]	[tmel]	"melt"	j.	[welʃ]	[ʃ.wel]	"Welsh"

The words in (6-10) end with a CC string which includes one or two obstruents. When these words are reversed, the reverse forms simply require the postvocalic obstruents to exchange with their preceding syllable, schematized as (6-11).

(6-11) Exchange of postvocalic obstruents and the preceding syllable

	Normal		**Reverse**	**Condition**
a.	$C_0VC_1C_2$	→	$C_2C_1C_0V$	(where both C_1 and C_2 are obstruents, e.g. *copse*)
b.	$C_0VC_1C_2$	→	$C_2C_0VC_1$	(where only C_2 is obstruent, e.g. *lump*)

The patterns in (6-11) is inconsistent with reversion training presented to the informants (cf. 4-13), which demonstrates the reversion of monosyllabic words through examples such as [tʌk] → [kʌt] and [tip] → [pit]. According to the training words, the word *corpse* in (6-10-a), for instance, are expected to be reversed as [psok] (under the interpretation to exchange the onset and the coda of a syllable) or [spok] (under the interpretation to reverse segmental sequence), none of which matches the actual form [spkoː]. When the postvocalic obstruents in the normal forms are viewed as syllables, (6-11) is explainable: the sequence in the reverse forms precisely mirrors the syllabic sequence in the normal forms. The phonological representation of *corpse* is thus more likely [ko.p.s].

The tendency to parse postvocalic obstruents as syllables is found not only in postvocalic CC strings, but also in singleton obstruent “codas”, shown through the examples below.

(6-12) Reversal of polysyllabic words ending with a singleton obstruent

	Normal	**Reverse**	
a.	[kæʃ.bæk]	[kbæʃ.kæ]	“cashback”
b.	[ʌn.də.peit]	[də.pei.də.ən]	“underpaid”
c.	[we.ə.ə.baut]	[tbau.ə.ə.we]	“whereabout”
d.	[fu.liʃ]	[ʃli.fuː]	“foolish”
e.	[ə.mius]	[smiu.ə]	“amuse”
f.	[in.kə.ritʃ]	[tʃ.ri.kə.in]	“encourage”

The normal forms in (6-12) end with a single obstruent. When reversed, the postvocalic obstruents (e.g. the [ʃ] and [k] in *cashback*) are split from the preceding CV structure and produce forms such as [kbæʃ.kæ] (for *cashback*) and [tʃ.ri.kə.in] (for *encourage*). Given the segmental sequence in the reverse forms, it is more reasonable to consider the postvocalic obstruents in the normal forms as syllables (which gives the actual reverse forms) than as codas (which gives [bæk.kæʃ] for *cashback*, and [ritʃ.kə.in] for *encourage*). Based on the reverse language data thus far, the rule in (6-13) can be advanced for the current I-grammar, which parses postvocalic obstruents as individual syllables.

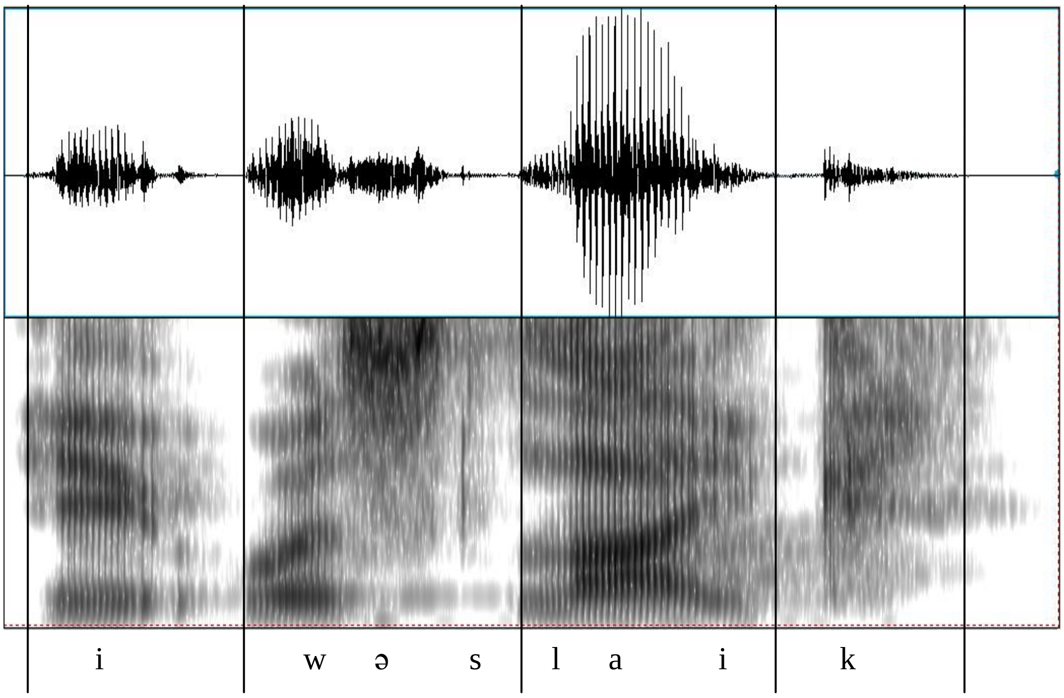
(6-13) Syllabification of postvocalic obstruents

$$\underset{[\text{-son}]}{\text{C}} \rightarrow \underset{[\text{-son}]}{.\text{C}} \;/\; \text{V} \left\{ \begin{array}{c} \varnothing \\ \text{C} \end{array} \right\} \_\_ \; \#$$

Legend: son – sonorant.

The rule in (6-13) is also supported by the phonetic evidence from the normal utterances. Consider the spectrograms in (6-14).

(6-14) Spectrogram of the utterance "*it was like*"



(6-14) shows the spectrogram of the utterance "*it was like*" where the tested word *like* is at the rightmost. Within the word, the duration of [lai] and of the final [k] are as follows.

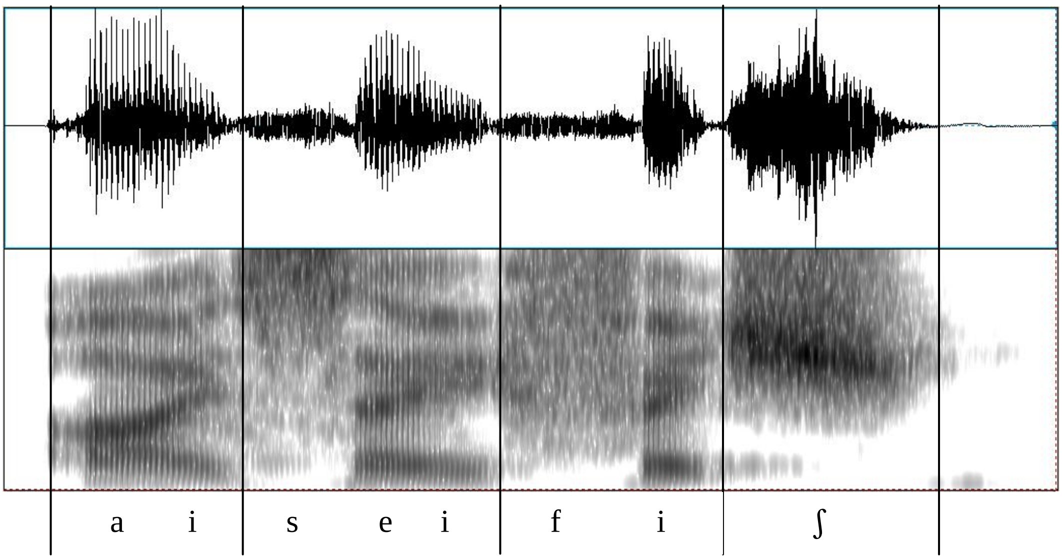
(6-15) Time proportion of *like*

	[lai]	[k]
Duration	0.343s	0.234s
Proportion	59.4%	40.6%

In (6-15), [lai] takes a longer time than [k]. Nonetheless, considering that [lai] has three continuant segments while there is only one non-continuant segment in [k], the time proportions of [lai] (59.4%) and [k] (40.6%) are rather unpredictable. There is likely an accentuation of the final [k], realized through strong aspiration. This accentuation is a potential hint of the syllabic [k].

When the postvocalic obstruent is continuant, its duration may even be longer than the preceding CV structure. As an illustration, (6-16) shows the spectrogram of the utterance "*I say fish*" which ends with the tested word *fish*.

(6-16) Spectrogram of the utterance "*I say fish*"



For the word *fish*, the time proportions of [fi] and [ʃ] are as (6-17).

(6-17) Time proportion of *fish*

	[fi]	[ʃ]
Duration	0.334s	0.342s
Proportion	49.4%	50.6%

[ʃ] is slightly longer than [fi] in duration, despite the fact that [fi] consists of two segments and the first segment is a fricative as well. The accentuation of [ʃ] is also reflected in intensity. As the waveform in (6-16) shows, [ʃ] is produced with higher amplitude than [fi]. The phonetic information hence serves as another cue for the syllabicity of postvocalic obstruents.[5]

In sum, evidence from the reverse language and from the phonetic measurements shows that the postvocalic obstruents in the normal-order speech are not true codas. Both the obstruents in "CC codas" and singleton obstruent "codas" tend to be parsed as syllabic obstruents. *ObsNuc hence ranks not only below *CC]σ, the constraint banning CC codas (cf. 5-14), but also below *CodaObs whose definition is provided in (6-18).

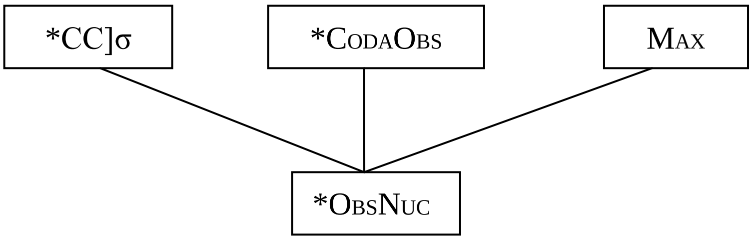
[5] As a matter of fact, when being asked how many parts C-V-obstruent words such as *fish* are composed of, the informant responded that *fish* is made up of two parts: [fi] and [ʃ]. This observation further supports the independence of postvocalic obstruents relative to the preceding CV.

(6-18) ***CodaObs:**

An obstruent in a coda position is unlicensed (Piggot 2003:413).

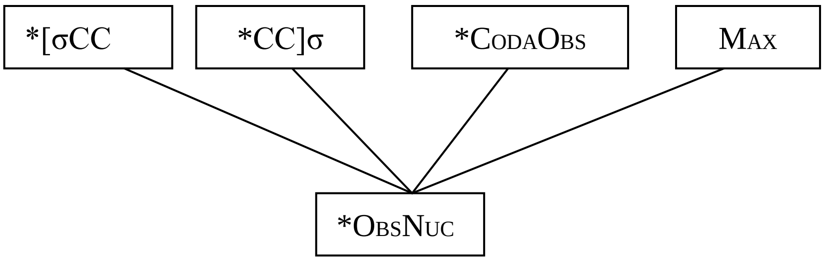
Given that all singleton obstruent codas and CC codas (except /nt/ and nd/) are prevented through obstruent syllabification than through other strategies, *ObsNuc is meanwhile dominated by faithfulness constraints such as Max. We then reach the constraint ranking in (6-19) regarding the codas in this I-language.

(6-19) Constraint ranking for the codas in the Type I I-language



By transitivity of domination (Kager 1999:21), (6-19) can be further combined with the onset constraint ranking in (6-7), giving the ranking in (6-20).

(6-20) Interim constraint ranking of the Type I I-grammar



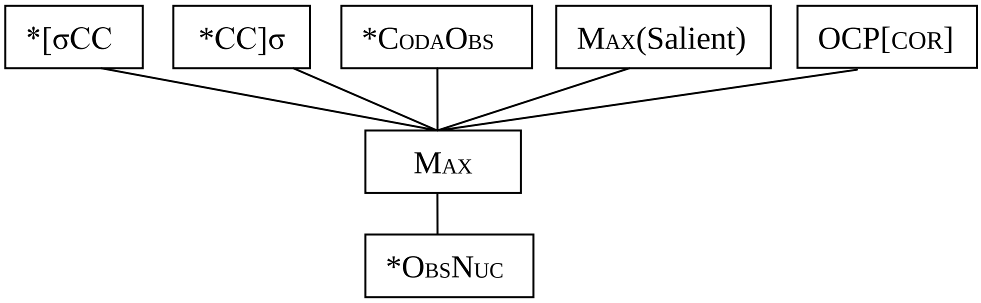
It should be noted that the above ranking will not affect the Max(Salient), OCP[cor] >> Max ranking in (6-4) which explains the deletion of the word-final /t/ and /d/ in coronal-coronal codas. Even if the final /nt/ and /nd/ are parsed as [n.t] and [n.d] in the candidate outputs, the [t] and [d] will still be omitted, under the effect of OCP[cor] (cf. 6-3) which applies to any adjacent coronals. This is demonstrated in (6-21) through the word *lend*.

(6-21) Evaluation tableau for *lend*

/lend/ “lend”	Max(Salient)	OCP[cor]	Max
len.d		*!	
lend		*!	
☞ len			*
le.d	*!		*

The rankings in (6-20) and (6-21) have captured the patterns observed in this I-language. Because of the Max >> *ObsNuc >> NoCoda ranking in (6-20), we get Max(Salient), OCP[cor] >> Max >> *ObsNuc >> NoCoda by transitivity. The three remaining constraints in (6-20) (i.e. *[σCC, *CC]σ, and *CodaObs) are better placed at the top stratum with Max(Salient) and OCP[cor], since there is no constraint enforcing the violations of the three and hence no reason to place them below any constraint. Ultimately, the overall constraint ranking of the Type I I-grammar is summarized as (6-22).

(6-22) Overall constraint ranking of the Type I I-grammar



6.1.2 Type II: Obstruent syllabification in /s/-stop onsets and obstruent codas

Compared with the Type I I-grammar, the Type II (observed in the informants GZ-F-23-01 and GZ-F-23-02) also uses obstruent syllabification as the major strategies to avoid unwanted structures. The consonant deletions found in the Type I, however, do not occur in the Type II.

In the normal-order speech, most consonant clusters are faithfully produced by the two informants. As the only difference with the Standard English (StdE), *cl*-initial words such as *close* and *cliff* are produced by GZ-F-23-01 as [kə.lous] and [kə.lif] where there is an [ə] presenting between [k] and [l]. This phenomenon, however, is not found in other stop-liquid onsets, e.g. *crow* is produced as [kɹou], *glue* as [gluː], *grape* as [gɹeip], *play* as [plei]. The fact that the inter-consonantal [ə] is restricted only to *cl*-initial words indicates that there is no general tendency in the I-grammar to insert a vowel to onset clusters. It is also hard to tell why the [ə] presents only in *cl*-initial words but not in other onsets. The [ə] is hence more likely to result from an /ə/ presenting in the underlying forms than from vowel epenthesis.[6] For this reason, the I-grammar of GZ-F-23-01 is no different from GZ-F-23-02 and makes no deletion or insertion to the CC clusters in the underlying forms.

When looking at the reverse language data, it turns out that the CC strings in the normal utterances are not necessarily complex onsets or codas. Regarding onsets, (6-23) presents how polysyllabic words containing a prevocalic CC string are inverted.

(6-23) Reversal of polysyllabic words containing a prevocalic CC string

a. GZ-F-23-01

	Normal	**Reverse**	
i.	[bɹi.tən]	[təm.bɹi]	"Britain"
ii.	[iŋ.kɹi.siŋ]	[siŋ.kɹi.iŋ]	"increasing"
iii.	[ə.pluf]	[fv.plu.ə]	"approve"
iv.	[dis.klem]	[klem.sdi]	"disclaim"
v.	[sgei.tiŋ]	[tiŋ.geis]	"skating"
vi.	[sbi.ɹi.tʃə]	[tʃə.ɹi.bis]	"spiritual"
vii..	[sdiu.bid]	[də.bi.dius]	"stupid"

b. GZ-F-23-02

	Normal	**Reverse**	
i.	[bɹi.tən]	[təm.bɹi]	"Britain"
ii.	[iŋ.kɹi.siŋ]	[siŋ.kɹi.in]	"increasing"

[6] The presence of the /ə/ in the underlying forms is possibly due to L2 speakers' misperception of foreign sounds. As is pointed out in Broselow (2015), onset clusters in a foreign language are not necessarily accurately perceived by non-native ears. Sometimes an illusory vowel is perceived between the obstruent and the liquid in obstruent-liquid onsets.

iii.	[ə.pɹuːf]	[f.pɹu.ə]	“approve”
iv.	[dis.kleim]	[kleim.sdi]	“disclaim”
v.	[sgeː.tiŋ]	[tiŋ.geːs]	“skating”
vi.	[sbi.ɹi.tʃou]	[tʃou.ɹi.piːs]	“spiritual”
vii.	[sdiu.pit]	[dpi.dius]	“stupid”

Signified by the dotted lines in (6-23-a) and (6-23-b), the reverse language data can be divided into two types, depending on whether the prevocalic CC sequences are preserved in the reverse utterances. For the instances above the dotted lines, the CC onsets in the normal forms are kept intact in the revere forms. This indicates that the prevocalic CC strings in these examples are true complex onsets.

For the instances under the dotted lines, the prevocalic CC strings in the normal forms are composed of a [s] and a stop. The [s] is always separated from the stop and behaves like a consonantal syllable in the reverse language. The word *skating* (in 6-23-a-v), for example, is produced as [sgei.tiŋ] in the normal speech and as [tiŋ.geis] in the reverse. Akin to the syllabic [s] observed in the Hong Kong study (cf. (5-3), (5-22)), the segmental sequence in the reverse forms suggests that the [s]-stop “onsets” in the normal forms are more likely a syllabic [s] plus a simple stop onset, expressible through the rule below.

(6-24) [s] syllabification in prevocalic /s/-stop strings

$$s \;\; \begin{bmatrix} C \\ \text{-cont} \\ \text{-son} \end{bmatrix} \rightarrow s\,. \;\; \begin{bmatrix} C \\ \text{-cont} \\ \text{-son} \end{bmatrix} \;\; / \;\#\_\_V$$

(6-24) involves a violation of *OBSNUC. Given the preservation of other CC onsets, this violation is not enforced by *[σCC, but by a constraint banning /s/-stops onsets, such as the SSP-ONS introduced in (5-6). With the ranking SSP-ONS >> *OBSNUC >> *[σCC, one accounts for the syllabic [s] on the one hand and the preservation of other CC onsets on the other. This is illustrated as (6-25-a) and (6-25-b).

(6-25) Evaluation tableaux for *skating* and *Britain*

a. /skeitiŋ/ "skating"	SSP-ONS	*OBSNUC	*[σCC
sgei.tiŋ	*!		*
☞ s.gei.tiŋ		*	

b. /bɹitən/ "Britain"	SSP-ONS	*OBSNUC	*[σCC
☞ bɹi.tən			*
b.ɹi.tən		*!	

Obstruent syllabification occurs also to the CC strings in coda position. This is demonstrated in (6-26) through the reversal of polysyllabic words which contain a postvocalic CC string.

(6-26) Reversal of polysyllabic words containing a postvocalic CC string

a. GZ-F-23-01

	Normal	**Reverse**	
i.	[dʌi.dʒest]	[təs.dʒe.dʌi]	"digest"
ii.	[in.di.pen.dənt]	[tə.dem.pen.di.in]	"independent"
iii..	[ɹe.kə.mənd]	[də.men.kə.ɹe]	"recommend"
iv.	[θeŋk.fəu]	[fəuk.θeŋ]	"thankful"
v.	[ʌi.tuns]	[stun.ʌi]	"i-Tunes"

b. GZ-F-23-02

	Normal	**Reverse**	
i.	[dʌi.dʒest]	[tsdʒe.dʌi]	"digest "
ii.	[in.di.pen.dənt]	[tə.dəm.pen.di.in]	"independent"
iii..	[ɹe.kəm.ment]	[də.men.kən.ɹe]	"recommend"
iv.	[θeŋk.fou]	[fouk.θen]	"thankful"
v.	[ai.tuns]	[stun.ai]	"i-Tunes"

As (6-26) shows, the CC "codas" in the normal forms are not preserved in the reverse speech. Take the word *independent* in (6-26-a-ii) as example. The reverse form [tə.dem.pen.di.in] suggests that the final [t] in the normal utterance is more likely a syllabic obstruent than part of an [nt] coda. By assuming the “coda” obstruents in the normal forms as individual syllables, all of the reverse forms in (6-26) become explicable. The postvocalic CC sequences in the normal speech are thus not codas.

Same as the Type I I-grammar in §6.1.1, obstruent syllabification happens even to singleton codas, shown through the examples below.

(6-27) Reversal of polysyllabic words ending with a singleton obstruent

a. GZ-F-23-01

	Normal	**Reverse**	
i.	[pʌ.ti.si.peit]	[tə.pei.si.ti.pʌ]	“participate”
ii.	[ʌn.də.peid]	[də.pei.də.aŋ]	“underpaid”
iii..	[kæʃ.bæk]	[kə.bæ.ʃi.kæ]	“cashback”
iv.	[ə.fɹeit]	[də.fɹei.ə]	“afraid”
v.	[ə.mius]	[smiu.ə]	“amuse”
vi.	[iŋ.kʌ.ɹitʃ]	[dʒi.ɹi.kʌ.in]	“encourage”

b. GZ-F-23-02

	Normal	**Reverse**	
i.	[paɹ.ti.si.peit]	[tə.pei.si.ti.paɹ]	“participate”
ii.	[ʌn.dəɹ.peit]	[də.pei.dəɹ.ʌn]	“underpaid”
iii..	[kaʃ.bæk]	[kə.bæʃ.kæ]	“cashback”
iv.	[ə.fɹeit]	[dfɹei.ə]	“afraid”
v.	[ə.mius]	[smiu.ə]	“amuse”
vi.	[in.kə.ɹitʃ]	[dʒi.ɹi.kə.in]	“encourage”

The normal utterances in (6-27) all end with a singleton obstruent. In the reverse forms, this obstruent is divided from its preceding syllable and moved as if an independent syllable. For instance, [tə.pei.si.ti.paɹ], which is the reverse form of *participate* (6-27-b-i), represents an inversion in syllabic sequence when the word-final [t] in the normal form [paɹ.ti.si.peit] is seen as a syllable. The obstruent “codas” in this I-grammar type are thus more likely syllabic obstruents.

The patterns of codas observed in (6-26) and (6-27) are identical to those in the Type I I-grammar (cf. (6-9) and (6-12)), and can be captured by the same constraint ranking: *CC]σ, *CodaObs, Max >> *ObsNuc (cf. 6-19). Together with the onset constrain ranking in (6-25), two rankings operate in this I-grammar type, presented below.

(6-28) a. Onset constraint ranking

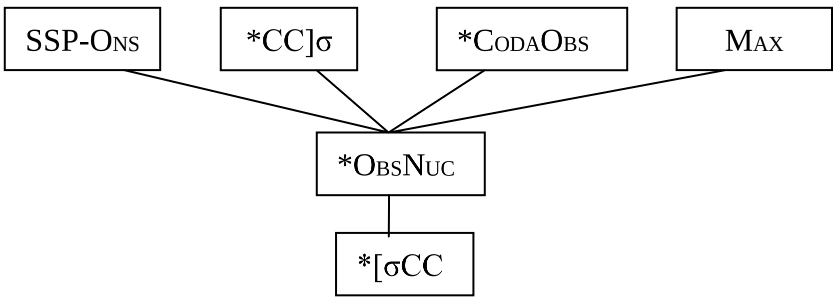
SSP-Ons >> *ObsNuc >> *[σCC

b. Coda constraint ranking

*CC]σ, *CodaObs, Max >> *ObsNuc

For monosyllabic words, the four top-ranked constraints in (6-28-a) and (6-28-b) (i.e. SSP-Ons, *CC]σ, *CodaObs, Max) are never violated. Since there is no evidence suggesting the higher rank of SSP-Ons over the other three or vice versa, the four constraints are on a par and form the top stratum of the overall constraint ranking. The *[σCC in (6-28-a) is below *ObsNuc and can be placed at the lowest stratum. The overall ranking hierarchy of the I-grammar type can thus be formulated as (6-29) as to monosyllabic words.[7]

(6-29) Overall constraint ranking of the Type II I-grammar



6.1.3 Type III: Obstruent syllabification in /s/-stop onsets and continuant obstruent codas

The Type III I-grammar, found in one informant (GZ-M-24-01), also avoids unaccepted structures by the violations of *ObsNuc.

[7] As is mentioned in Chapter 5, Note 7, the constraint rankings of monosyllabic words have been sufficient for the test to the ETT, because the tethering effect of the E-grammar is examined in the language attitude test (see §6.3) through monosyllabic words.

In the normal-order utterances, the CC clusters in onset and coda positions are preserved by the informant. For example, *close* is pronounced as [klous], *blunt* as [blʌnt], *lift* as [lift], *lump* as [lʌmp]. Such preservation suggests the high rank of faithfulness constraints such as MAX and DEP.

Turning to the reverse language data, it appears that not all of the CC clusters in the normal-order speech are true complex syllable margins. This is first illustrated in (6-30) through the reversal of polysyllabic words which begin with a CC "onset".

(6-30) Reversal of polysyllabic words beginning with a CC string

	Normal	**Reverse**	
a.	[klou.ʃə]	[ʃə.klou]	"closure"
b.	[bɹi.tən]	[tən.bɹi]	"Britain"
c.	[pɹe.si.dən.si]	[si.dən.si.pɹe]	"presidency"
d.	[fɹeʃ.nis]	[sniʃ.fɹe]	"freshness"
e.	[sgei.tiŋ]	[tiŋ.geis]	"skating"
f.	[sbi.ɹi.tʃəl]	[tʃəl.ɹi.bis]	"spiritual"
g.	[sbeː.ə]	[ə.beːs]	"spare"
h.	[sdiu.bit]	[bi.dius]	"stupid"

For the examples above the dotted line, the word-initial CC functions as the onset of the same syllable (e.g. the [klou] in *closure*; the [bɹi] in *Britain*) in both the normal and the reverse forms. This is an indication that CC onsets are allowed in the I-grammar.

The normal forms under the dotted lines (from (6-30-e) to (6-30-h)) begin with an [s]-stop sequence. When being reversed, the initial [s] moves away from the following stop and produces reverse forms such as [tʃəl.ri.bis] (for *spiritual* in (6-30-f)). Like the syllabic [s] observed in the previous I-grammar, these reverse forms imply that the [s]-stop strings in the normal forms are in fact a syllabic [s] followed by a stop onset. Described in OT, this can be expressed through the same constraint ranking in the previous I-grammar:

(6-31) SSP-ONS >> *OBSNUC >> *[σCC

For coda clusters, a mixed pattern is found from the reverse language, depending on whether the clusters contain a continuant obstruent. (6-32) demonstrates this through the reversal of polysyllabic words containing a CC "coda".

(6-32) Reversal of polysyllabic words containing postvocalic CC strings

	Normal	**Reverse**	
a.	[æŋk.lit]	[lit.æŋk]	"anklet"
b.	[fenk.fu]	[fou.feŋk]	"thankful"
c.	[iŋg.liʃ]	[ʃi.li.iŋk]	"English"
d.	[wut.lent]	[lent.wuːt]	"woodland"
e.	[ai.tyns]	[stun.ai]	"i-Tunes"
f.	[si.kwəns]	[skwən.siː]	"sequence"

For the instances above the dotted line, the postvocalic CC strings in the normal forms (e.g. the [ŋk] in *anklet*; the [ŋg] in *English*) do not include a continuant obstruent. In the reverse forms, these CC strings are retained as codas.

When postvocalic CC strings contain a continuant obstruent, obstruent syllabification will take place, as can be found in (6-32-e) and (6-32-f). For example, [skwən.siː], which is the reverse form of *sequence* (6-32-f), does not preserve the [ns] coda in the normal form but requires the [s] to move like a syllable.

The syllable status of postvocalic continuant obstruents is also supported by the reversal of singleton "coda" words, shown in (6-33). The dotted line in (6-33) divides the words ending with a continuant obstruent from those which do not.

(6-33) Reversal of polysyllabic words ending with a singleton obstruent

	Normal	**Reverse**	
a.	[ə.fɹeit]	[fɹeit.ə]	"afraid"
b.	[in.de.fi.nit]	[nit.fi.de.in]	"indefinite"
c.	[fe.bɹik]	[bɹik.feː]	"fabric"

d.	[ɹi.lei.ʃən.ʃip]	[ʃip.ʃən.lei.ɹi]	"relationship"
e.	[ə.mjus]	[smju.ə]	"amuse"
f.	[ə.pɹuːf]	[fə.pɹu.ə]	"approve"
g.	[fu.liʃ]	[ʃli.fuː]	"foolish"
h.	[in.kʌ.ɹitʃ]	[dʒi.ɹi.kʌ.ən]	"encourage"

While word-final non-continuant obstruents (as shown from (6-33-a) to (6-33-d)) are preserved in the reverse forms as codas, final continuant obstruents (from (6-33-e) to (6-33-h)) tend to be treated as syllables in the reverse utterances. This contrast further confirms the special status of postvocalic continuant obstruents as opposed to other postvocalic consonants. The rule below, proposed in (5-13-b) to describe the syllabification of postvocalic continuant obstruents in Hong Kong English (HKE), applies to this I-grammar.

(6-34) Syllabification of postvocalic continuant obstruents

$$\underset{\begin{bmatrix}\text{-son}\\ \text{+cont}\end{bmatrix}}{\text{C}} \rightarrow \underset{\begin{bmatrix}\text{-son}\\ \text{+cont}\end{bmatrix}}{.\text{C}} \;/\; \text{V}\_\_\_\#$$

(6-34) can be stated in OT by putting *ObsNuc below *[-son,+cont $_{\text{CODA}}$], a constraint prohibiting continuant obstruent codas (cf. (6-16)). Since the other codas are allowed, *ObsNuc is in turn above *CC]σ and *CodaObs. The following ranking therefore operates in the I-grammar: *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> *CC]σ, *CodaObs.

The above ranking, in addition to the onset constraint ranking in (6-31), explains the obstruent syllabification in onset and coda. Since the disallowed structures (i.e. /s/-stop onsets and continuant obstruent codas) are not prevented through other repairing strategies, Max should also be above *ObsNuc. We then arrive at the two rankings in (6-35).

(6-35) a. Onset constraint ranking

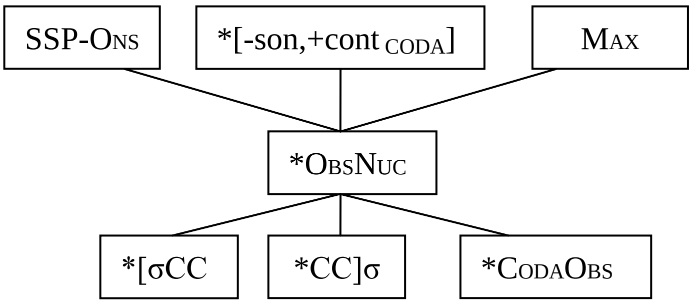
Max, SSP-Ons >> *ObsNuc >> *[σCC

b. Coda constraint ranking

Max, *[-son,+cont $_{\text{CODA}}$] >> *ObsNuc >> *CC]σ, *CodaObs

The highest-ranked constraints in (6-35-a) and (6-35-b) are never violated and constitute the top stratum of the overall ranking hierarchy. The bottom-ranked constraints in (6-35-a) and (6-35-b) all are dominated by *ObsNuc. Since the lowest *[σCC in (6-35-a) does not clash with the two bottom-ranked constraints in (6-35-b) for monosyllabic words, they can be treated together as the lowest stratum. The overall constraint ranking of the I-grammar is ultimately shown as (6-36) for monosyllabic words.

(6-36) Overall constraint ranking of the Type III I-grammar



6.1.4 Type IV: Deletion of coronal-coronal codas

The Type IV I-grammar is found in three informants (GZ-M-25-01, GZ-M-21-01, GZ-M-20-01). In this I-grammar type, the only unacceptable structures are coronal-coronal codas, which are avoided through consonant deletions.

In the normal-order speech, the three informants preserve the majority of CC onsets and CC codas. Nonetheless, for coronal-coronal codas, the final /t/ and /d/ tend to be omitted,[8] shown through the examples in (6-37).

(6-37) Deletion of the final /t/ and /d/ in coronal-coronal codas

a. GZ-M-25-01

i.	[seg.mʌn]	"segment"
ii.	[iːn.stɹaʔ.mʌn]	"instrument"
iii.	[ɹʌ.kə.mæːn]	"recommend"
iv.	[ʌn.də.stæːn]	"understand"
v.	[dai.dʒes]	"digest"

[8] Following the –*ing* suffix test introduced in §5.1.3, it has been ascertained that the /t/ and the /d/ exist in the underlying forms.

b. GZ-M-21-01

i.	[sek.men]	"segment"
ii.	[in.stɹu.mən]	"instrument"
iii.	[ɹi.kəm.men]	"recommend"
iv.	[ʌn.də.sden]	"understand"
v.	[dʌi.dʒes]	"digest"

c. GZ-M-20-01[9]

i.	[seg.mən]	"segment"
ii.	[ins.tɹə.mən]	"instrument"
iii.	[ɹe.kə.men]	"recommend"
iv.	[ʌn.də.sden]	"understand"

The above deletions can be stated as the rule below:

(6-38) Deletion of the final /t/ and /d/ in coronal-coronal codas

$$t\ /\ d \rightarrow \varnothing\ /\ \underset{\substack{|\\ [\text{coronal}]}}{C}\ \_\_\ \#$$

(6-38) is derivable in OT by the ranking MAX(Salient), OCP[COR] >> MAX, advocated also in the Type I I-grammar (cf. (6-4)). OCP[COR] explains why deletions happen to coronal-coronal clusters; MAX(Salient) accounts for why only final /t/ and /d/ are deleted.

Because of the preservation of other CC clusters, MAX in turn outranks *[σCC, *CC]σ and *CODAOBS. The ranking below is thus achieved based on the normal-order data:

(6-39) MAX(Salient), OCP[COR] >> MAX >> *[σCC, *CC]σ, *CODAOBS

---

[9] The word *digest* (cf. (6-37-a-v), (6-37-b-v)) is produced by this informant as [dʌi.dʒest]. Yet there is still evidence for the tendency to simplify the [st] coda. For example, the reverse language form of *digest* is [dʒes.dʌi] where the /t/ is absent.

Judged from the reverse language, it is confirmed that the consonant clusters in the normal speech are true complex syllable margins. Some of the examples are as follows.

(6-40) Retention of CC onsets and CC codas in polysyllabic reversal

a. GZ-M-25-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.tʌn]	[tʌn.bɹi]	"Britain"
	ii.	[klou.θeŋ]	[θeŋ.klou]	"clothing"
	iii.	[skei.tiŋ]	[teŋ.skei]	"skating"
CC coda	iv.	[seːns.lʌs]	[lis.sæns]	"senseless"
	v.	[eks.hæːw]	[heːw.eks]	"exhale"
	vi.	[θæŋk.fʌu]	[fʌu.θæŋk]	"thankful"

b. GZ-M-21-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.tən]	[təm.bɹi]	"Britain"
	ii.	[klou.siŋ]	[siŋ.klou]	"clothing"
	iii.	[sgei.tiŋ]	[tiŋ.sgei]	"skating"
CC coda	iv.	[sens.lis]	[lis.sens]	"senseless"
	v.	[eks.hel]	[hel.eks]	"exhale"
	vi.	[θeŋk.fəl]	[fəl.θeŋk]	"thankful"

c. GZ-M-20-01

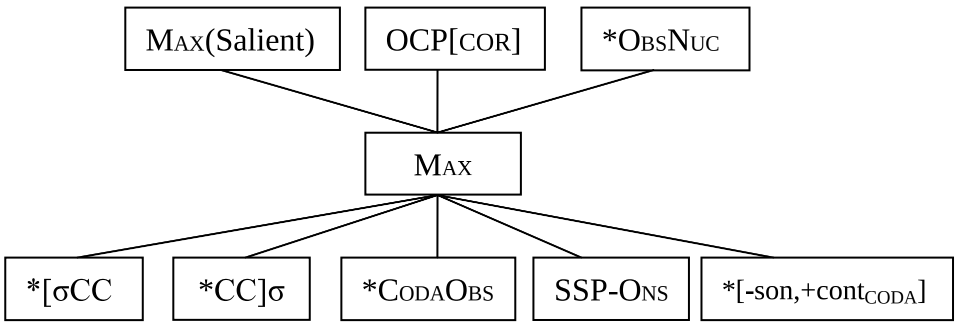
		Normal	**Reverse**	
CC onset	i.	[bɹi.tən]	[tən.bɹi]	"Britain"
	ii.	[klou.θiŋ]	[θiŋ.klou]	"clothing"
	iii.	[sge.tiŋ]	[tiŋ.sgei]	"skating"
CC coda	iv.	[sens.nis]	[nis.sens]	"senseless"
	v.	[iks.hel]	[hel.iks]	"exhale"
	vi.	[feŋk.fəu]	[fəu.feŋk]	"thankful"

In (6-40), the CC onsets and CC codas in the normal forms are retained in the reverse forms. Such retention indicates that *ObsNuc is inviolate and ranks above the constraints requiring the break-up of consonant clusters. The ranking in (6-41) thus operates:

(6-41) *ObsNuc >> *[σCC, *CC]σ, *CodaObs, SSP-Ons, *[-son,+cont$_{\text{CODA}}$]

The overall ranking of the I-grammar is obtainable by combining (6-41) with (6-39). The inviolate *ObsNuc can be put at the top stratum with Max(Salient) and OCP[cor], as there is no reason to rank them below any constraint. Also, since the I-grammar shows no sign of prohibiting /s/-stop onsets and continuant obstruent codas, SSP-Ons and *[-son,+cont$_{\text{CODA}}$] can be placed at the bottom, on a par with *[σCC, *CC]σ and *CodaObs. The overall ranking of this I-grammar is therefore presented as (6-42).

(6-42) Overall constraint ranking of the Type IV I-grammar



6.1.5 Type V: Full retention of CC clusters

The final I-grammar type, found in three Guangzhou informants (GZ-F-22-01, GZ-F-22-02, GZ-F-23-03), fully retains the CC clusters in the StdE.

In the normal speech, CC onsets and codas are faithfully produced by the three informants. Some examples are shown below.

(6-43) Preservation of CC clusters in the normal-order speech

a. GZ-F-22-01

CC-onset words			CC-coda words		
i.	[bləːɹ]	“blur”	v.	[iŋk]	“ink”
ii.	[kɹai]	“cry”	vi.	[blont]	“blunt”

iii.	[fluː]	"flu"	vii.	[lift]	"lift"
iv.	[staː]	"star"	viii.	[auns]	"ounce"

b. GZ-F-22-02

CC-onset words			CC-coda words		
i.	[bləː]	"blur"	v.	[iːŋk]	"ink"
ii.	[kɹai]	"cry"	vi.	[blʌnt]	"blunt"
iii.	[fluː]	"flu"	vii.	[liːft]	"lift"
iv.	[staː]	"star"	viii.	[aːŋs]	"ounce"

c. GZ-F-23-03

CC-onset words			CC-coda words		
i.	[bləː]	"blur"	v.	[iŋk]	"ink"
ii.	[kɹai]	"cry"	vi.	[blʌnt]	"blunt"
iii.	[fluː]	"flu"	vii.	[lift]	"lift"
iv.	[sdaːɹ]	"star"	viii.	[ons]	"ounce"

Given the preservation of consonant clusters, faithfulness constraints should be ranked high in the grammar to prevent modifications to consonant clusters.

By scrutinizing the reverse language data, one can also confirm the clusters in the normal speech as true complex syllable margins. This is illustrated in (6-44) through the reversal of polysyllabic words containing an onset or coda cluster.

(6-44) Retention of CC onsets and CC codas in polysyllabic reversal

a. GZ-F-22-01

		Normal	**Reverse**	
CC onset	i.	[bɹi.tən]	[tən.bɹi]	"Britain"
	ii.	[klou.fiŋ]	[θiŋ.klou]	"clothing"
	iii.	[spi.ɹi.tʃəu]	[tʃou.ɹi.spi]	"spiritual"
CC coda	iv.	[æŋk.lit]	[lit.æŋk]	"anklet"
	v.	[seg.mənt]	[mənt.sek]	"segment"
	vi.	[si.kwəns]	[kwəns.siː]	"sequence"

b. GZ-F-22-02

		Normal	Reverse	
	i.	[bɹiː.tʌn]	[tʌm.bɹiː]	“Britain”
CC onset	ii.	[klʌu.siŋ]	[siŋ.klou]	“clothing”
	iii.	[spiː.ɹiː.tʃʌu]	[tʃʌu.ɹiː.spiː]	“spiritual”
	iv.	[æŋk.læt]	[læk.æŋk]	“anklet”
CC coda	v.	[sæg.mʌnt]	[mʌnt.sæg]	“segment”
	vi.	[siː.kwʌns]	[kwʌns.siː]	“sequence”

c. GZ-F-23-03

		Normal	Reverse	
	i.	[bɹi.tən]	[tʌm.bɹi]	“Britain”
CC onset	ii.	[klo.θiŋ]	[θiŋ.klo]	“clothing”
	iii.	[sbi.ɹi.tʃou]	[tʃou.ɹi.sbi]	“spiritual”
	iv.	[enk.lit]	[lit.enk]	“anklet”
CC coda	v.	[seg.mənt]	[mənt.sek]	“segment”
	vi.	[sik.kwəns]	[kwəns.si]	“sequence”

The reverse forms in (6-44) preserve the CC onsets or codas in the normal utterances, suggesting that obstruent syllabification does not occur to syllable margins. *ObsNuc is hence ranked high in the constraint ranking.

Knowing the high rank of *ObsNuc and faithfulness constraints, one is able to deduce the constraint ranking of the current I-grammar by rearranging the constraints in (6-42). By placing *ObsNuc, Max, and Max(Salient) in (6-42) at the top of the ranking, and the other constraints that trigger the break-up of consonant clusters at the bottom, one can then achieve a grammar which retains the full range of consonant clusters in the StdE, shown as (6-45).

(6-45) Constraint ranking of the Type V I-grammar

{*ObsNuc, Max, Max(Salient)}

|

{*[σCC, *CC]σ, *CodaObs, SSP-Ons, *[-son,+cont$_{CODA}$], OCP[cor]}

6.1.6 Interim summary

In sum, the 10 English speakers in Guangzhou exhibit five types of I-grammar with respect to consonant clusters, summarized as follows.

(6-46) I-grammar types in the Guangzhou study

Type I: Obstruent syllabification with deletion of coronal-coronal codas

Number of speakers: 1

Ranking hierarchy:

MAX(Salient), *[σCC, *CC]σ, *CODAOBS, OCP[COR] >> MAX >> *OBSNUC

Type II: Obstruent syllabification in /s/-stop onsets and obstruent codas

Number of speakers: 2

Ranking hierarchy:

MAX, SSP-ONS, *CC]σ, *CODAOBS >> *OBSNUC >> *[σCC

Type III: Obstruent syllabification in /s/-stop onsets and continuant obstruent codas

Number of speakers: 1

Ranking hierarchy:

MAX, SSP-ONS, *[-son,+cont $_{\text{CODA}}$] >> *OBSNUC >> *[σCC, *CC]σ, *CODAOBS

Type IV: Deletion of coronal-coronal codas

Number of speakers: 3

Ranking hierarchy:

MAX(Salient), OCP[COR], *OBSNUC >> MAX >> *[σCC, *CC]σ, *CODAOBS, *[-son,+cont $_{\text{CODA}}$], SSP-ONS

Type V: Full retention of CC clusters (also the same as the StdE grammar)

Number of speakers: 3

Ranking hierarchy:

MAX(Salient), MAX, *OBSNUC >> *[σCC, *CC]σ, *CODAOBS, *[-son,+cont$_{\text{CODA}}$], SSP-ONS, OCP[COR]

The I-grammar types in (6-46) are described as five distinct constraint rankings. These rankings differ from one another both in the constraints that have been used and in the number of the constraints. To make the I-grammar types comparable, the set of constraints should be the same across the I-grammar types. This can be done by adding the constraints that have been used in some rankings but not in others into all the rankings, following the approach presented in §5.1.7 (p. 88). The never-violated constraints can be put into the existing top stratum, as there is no reason to place them below any constraint; the constraints that are often violated and never enforce the violations of the others can be put to the existing bottom. The ranking hierarchies in (6-46) can then be expressed as (6-47) with the same constraints, which in fact represents a gradual progression towards the StdE from the Type I to the Type V.

(6-47) I-grammar ranking hierarchies in the Guangzhou study

Type I:

Max(Salient), *[σCC, *CC]σ, *CodaObs, *[-son,+cont$_{\text{CODA}}$], SSP-Ons, OCP[cor] >> Max >> *ObsNuc

Type II:

Max(Salient), Max, *CC]σ, *CodaObs, *[-son,+cont$_{\text{CODA}}$], SSP-Ons >> *ObsNuc >> *[σCC, OCP[cor]

Type III:

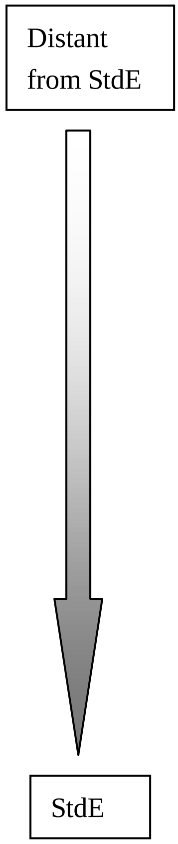
Max(Salient), Max, SSP-Ons, *[-son,+cont$_{\text{CODA}}$] >> *ObsNuc >> *[σCC, *CC]σ, *CodaObs, OCP[cor]

Type IV:

Max(Salient), *ObsNuc, OCP[cor] >> Max >> *[σCC, *CC]σ, *CodaObs, *[-son,+cont$_{\text{CODA}}$], SSP-Ons

Type V:

Max(Salient), Max, *ObsNuc >> *[σCC, *CC]σ, *CodaObs, *[-son,+cont$_{\text{CODA}}$], SSP-Ons, OCP[cor]



The progression from the Type I to the Type V is backed by two kinds of evidence. First, the ranking distance with the StdE grammar (i.e. the Type V in (6-47)) decreases from the Type I to the Type IV. Based on the measurement of ranking distance introduced in Appendix 1, (6-48) presents the numeric distances between the Type V and the Types I, II, III and IV.

(6-48) Numeric ranking distances with the StdE (the Type V) ranking

	Rankings compared	**Numeric distance**
a.	Type I vs. Type V	33
b.	Type II vs. Type V	26
c.	Type III vs. Type V	18
d.	Type IV vs. Type V	11

In (6-48), the numeric distance with the Type V reduces from the Type I to the Type IV, indicating that the way the constraints are ranked gradually approximates the Type V.

The second piece of evidence is from the scope of disallowed structures in each I-grammar type, listed as (6-49).

(6-49) Disallowed structures in each I-grammar type

Type	**Unaccepted structures**
Type I	1. CC onsets; 2. CC codas; 3. Singleton obstruent codas; 4. Final coronal-coronal consonant strings.
Type II	1. /s/-stop onsets; 2. CC codas; 3. Singleton obstruent codas.
Type III	1. /s/-stop onsets; 2. Continuant obstruent codas.
Type IV	Coronal-coronal codas.
Type V	None.

As (6-49) shows, the scope of disallowed structures generally shrinks from the Type I to the Type V. The unaccepted structures in the Type I form a superset of those in the Type II which in turn include the disallowed structures in the Type III. Although the Type IV bans coronal-coronal codas which are acceptable to the Type III, it does not change the fact that a larger set of clusters are banned in the

Type III than in the Type IV, because the Type III has difficulties with both onset and coda clusters while the Type IV only has problem with coronal-coronal codas.

In the progression from the Type I to the Type V, one can further deduce two specific learning routes for the English learners in Guangzhou. Both routes require the continuous demotions of the markedness constraints which trigger the break-up of consonant clusters. The first learning route is identified from the I-grammar Types I, II, III and V, shown as (6-50). The constraints that have been demoted are marked by underlines.

(6-50) Demotions of markedness constraints in the first learning route

Type I: MAX(Salient), *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS, *[σCC, OCP[COR] >> MAX >> *OBSNUC

⇩ demoting *[σCC and OCP[COR]

Type II: MAX(Salient), *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS, MAX >> *OBSNUC >> *[σCC, OCP[COR]

⇩ demoting *CC]σ and *CODAOBS

Type III: MAX(Salient), *[-son,+cont$_{CODA}$], SSP-ONS, MAX >> *OBSNUC >> *[σCC, OCP[COR], *CC]σ, *CODAOBS

⇩ demoting *[-son,+cont$_{CODA}$] and SSP-ONS

Type V: MAX(Salient), MAX, *OBSNUC >> *[σCC, OCP[COR], *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS

(Legend: The underlines denote the newly demoted constraints.)

The second learning route can be deduced from the I-grammar Types I, IV and V. (6-51) below demonstrates how the constraints that forbid consonant clusters are gradually demoted in this learning route.

(6-51) Demotions of markedness constraints in the second learning route

Type I: MAX(Salient), *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS, *[σCC, OCP[COR] >> MAX >> *OBSNUC

⇩ demoting *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS, *[σCC

Type IV: MAX(Salient), OCP[COR], *OBSNUC >> MAX >> *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS, *[σCC

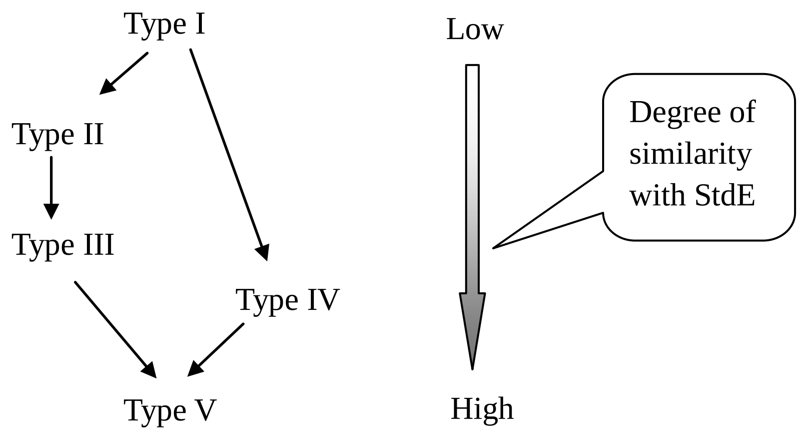
⇩ demoting OCP[COR]

Type V: MAX(Salient), *OBSNUC , MAX >> *CC]σ, *CODAOBS, *[-son,+cont$_{CODA}$], SSP-ONS, *[σCC, OCP[COR]

(Legend: The underlines denote the newly demoted constraints.)

The constraint re-ranking in (6-50) and (6-51)[10] allows one to envisage how consonant clusters are acquired by the Guangzhou people. On the basis of the two learning routes, the developmental stages of the Guangzhou I-grammars can be summarized as (6-52).

(6-52) Developmental stages of the Guangzhou I-grammars



As the final remark, the Type I I-grammar in (6-52), which is the starting point of both learning routes, forbids even the structures that are accepted in the L1 Cantonese. For example, singleton /p/, /t/ and /k/ codas, which are legitimate in Cantonese, are avoided in the Type I I-grammar through obstruent syllabification. This implies that the initial state of L2 acquisition is not

[10] Admittedly, the transitions of the I-grammar types in (6-51) are not sheer constraint demotions. The constraints that preserve consonant clusters, such as MAX and *OBSNUC, may be promoted. This, however, never means that the Constraint Demotion Algorithm (CDA) (Tesar & Smolensky 1998, 2000; cf. §3.3) does not apply to L2 acquisition. That sheer constraint demotions do not completely fit is probably due to the difference in research paradigm. The CDA focuses on individual speakers and may require longitudinal studies to show how a grammar evolves within the same speaker over a period of time. This study, on the other hand, derives the learning path from different I-grammars. In any case, the continuous demotions of markedness constraints in (6-51) have sufficed to show the trend to approximate the StdE and are consistent with the CDA.

necessarily the learner's L1 (cf. the Full Transfer hypothesis; Schwartz & Sprouse 1994, 1996). Instead, L2 acquisition may start at a point even lower than the L1, probably at the default setting of UG (cf. the No Transfer hypothesis; Epstein et al. 1996, 1998).

Assuming UG as the initial state, however, would fail to explain the low rank of *OBSNUC in the Type I I-grammar, because there is no reason in UG to low rank *OBSNUC, especially given that marked structures such as syllabic obstruents are not preferred in UG. As has been pointed out in §5.2, the violations of *OBSNUC can be transferred from the L1 Cantonese. For example, Cantonese accepts truncated forms such as [hɐm.p.lɐŋ] and [san.k.la] which require the low rank of *OBSNUC.

Based on the above reasons, the initial L2 state of the Guangzhou speakers is more reasonably a mixture of UG and the L1. This finding excludes neither the role of UG nor the involvement of the L1 in the initial state of L2 acquisition. It thus further confirms the neutral view of the ETT on this issue (cf. §1.4.1), that is, L2 acquisition may start either from the L1 setting, the default UG setting, or a mixture of the both.

While uncovering the developmental stages of L2, the I-grammars found in the Guangzhou study also allow for the identification of the E-grammar of GZE, which is the topic of the next section.

6.2 The E-grammar of GZE

Like the Hong Kong study (cf. §5.2), the E-grammar of GZE is summarized in (6-53) (see page 136) as a range covering the five I-grammar types in (6-47).

In (6-53), the E-grammar of GZE is denoted by the range E_{GZ}. The range starts with the Type I constraint ranking in (6-47) and ends with the Type V which is the same as the StdE ranking. The intermediate rankings in the E_{GZ}, as have been stated in the previous subsection, represent a gradual progression towards the StdE. Under each ranking, the scope of unaccepted clusters and the repairing strategies by which these clusters are avoided are provided. Outside the E-grammar range, there can be a number of possible grammars that either tolerate a smaller set of structures (e.g. the UG Default State in (6-53) which accepts only CV syllables), or go beyond the set of accepted clusters in the StdE. To formalize

(6-53) A schematic representation of the E-grammar of GZE (E_{GZ})

E_{GZ}

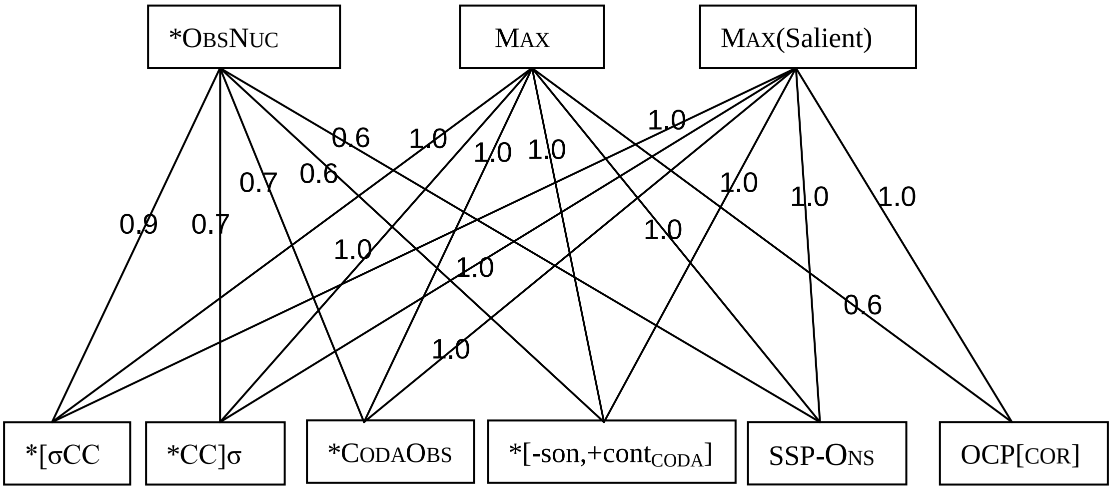
UG Default State: ABCDEFG >> HI	*Type I*: ABCDEFH >> I >> G	*Type II*: BCDEHI >> G >>AF	*Type III*: DEHI >> G >> ABCF	*Type IV*: FGH >> I >> ABCDE	*Type V (The StdE ranking)*: GHI >> ABCDEF
Cannot accept: 1.CC onsets; 2.all codas in general.	*Cannot accept:* 1.CC onsets; 2.CC codas; 3.simple obstruent codas. 4.Coronal-coronal final sequence.	*Cannot accept:* 1./s/-stop onsets; 2.CC codas; 3.simple obstruent codas.	*Cannot accept:* 1./s/-stop onsets; 2.continuant obstruent codas.	*Cannot accept:* 1.coronal-coronal codas.	*Cannot accept:* None.
Repairing strategy: Consonant deletion.	*Repairing strategies:* 1.syllabic obstruent; 2.consonant deletion.	*Repairing strategy:* Syllabic obstruent.	*Repairing strategy:* Syllabic obstruent.	*Repairing strategy:* Consonant deletion.	

Legend:

A: *[σCC B: *CC]σ C: *CodaObs D: *[-son,+cont $_{\text{CODA}}$]
E: SSP-Ons F: OCP[cor] G: *ObsNuc H: Max(Salient)
I: Max

this E-grammar system, (6-54) shows the overall ranking of the revenant constraints.

(6-54) Ranking hierarchy of the E-grammar of GZE



Generalized from (6-54), the occurring frequencies of the crucial sub-rankings that cause the break-up of consonant clusters are presented as (6-55).

(6-55) Frequencies of the rankings causing the break-up of CC clusters

Among the *ten* I-grammars, SSP-Ons >> *ObsNuc occurs *four* times;
*[-son,+cont$_{\text{CODA}}$] >> *ObsNuc occurs *four* times;
Max(Salient) >> OCP[Cor] >> Max occurs *four* times;
*CC]σ >> *ObsNuc occurs *thrice*;
*CodaObs >> *ObsNuc occurs *thrice*;
*[σCC >> *ObsNuc occurs *once*.

Except the above rankings, consonant clusters are preserved by the E-grammar in all the other cases. The general tendency in GZE is hence to faithfully produce consonant clusters. Whenever the break-up of consonant clusters is unavoidable, as (6-55) shows, the pressure to prevent the unwanted structures normally leads to the violations of *ObsNuc or Max, which cause obstruent syllabification and consonant deletions respectively. With a closer look at (6-55), the patterns in (6-56) are predicted to prevail in GZE.

(6-56) Patterns of consonant clusters in the E-grammar of GZE

a. In most cases consonant clusters are preserved in GZE.

b. In terms of position, onset clusters (except s-/stop/ onsets) are more stable than coda clusters, because *[σCC outranks *ObsNuc only once whereas *[-son,+cont $_{\text{CODA}}$], *CC]σ, and *CodaObs all dominate *ObsNuc for no less than three times. Moreover, the Max(Salient) >> OCP[cor] >> Max ranking only leads to the deletion of coda clusters.
c. In terms of cluster types, /s/-stop onsets (violating SSP-Ons), codas containing continuant obstruents (simultaneously violating *CodaObs and *[-son,+cont$_{\text{CODA}}$]), and codas violating OCP[cor] are least stable.
d. In terms of modification strategies, consonant clusters are avoided by parsing the cluster members as syllabic obstruents or by deletion. When deletion occurs, perceptually non-salient segments (cf. (5-35)) are usually deleted.

According to the ETT, the E-grammar of GZE should have a force of attraction (i.e. the E-tether) on the English speakers in Guangzhou. Given that the E-grammar of GZE, contains both the components identical to the StdE and those distinguishing GZE from the StdE (e.g. the low rank of *ObsNuc), the ETT would predict at least some of the "non-standard" components in GZE to be positively perceived by the Guangzhou people. In the following section, whether or not such prediction is attested will be discussed.

6.3 The tethering effect of GZE

To check whether the Guangzhou people incline towards GZE, this section examines the results of the language attitude test introduced in §4.5.2, which surveyed 66 Guangzhou people's degree of preference for different constraint rankings as to consonant clusters. Some of the rankings are found in GZE; some others are not.

Specifically, the 66 participants heard 36 tested words which represent 36 different consonant clusters in English. For each tested word, there were four phonetic variants, each corresponding to the demotion of a particular constraint, exemplified in (6-57) through the tested word *rent*. Upon hearing a phonetic variant, the participants were to indicate whether they like that variant in a 5-point scale.

(6-57) The constraint rankings represented by the phonetic variants of *rent*

	Variants	**Ranking testing for**	**Remark**
a.	[ɹent]	MAX, DEP, *OBSNUC >> *CC	demoting *CC
b.	[ɹen]	*CC, DEP, *OBSNUC >> MAX	demoting MAX
c.	[ɹen.t]	*CC, DEP, MAX >> *OBSNUC	demoting *OBSNUC
d.	[ɹen.tə]	*CC, MAX, *OBSNUC >> DEP	demoting DEP

To determine the most desired form for each cluster, the phonetic variant that receives the highest mean score is identified (see Appendix 7-A for the full list of mean scores). Any variant that is statistically similar to the highest-rated one is also equally counted as preferred, based on a Student Newman Keuls (SNK) test ($p = 0.05$). As such, (6-58) presents, for each cluster, the constraint(s) whose low rank is most attitudinally preferred.

(6-58) Preferred constraint rankings for each cluster type

a. Preferred constraint rankings for onset clusters

i.	Onset tested (*word*)	[kl] *clear*	[kɹ] *cry*	[pɹ] *pray*	[fl] *fly*
	Constraint to be ranked low	*CC	*CC	*CC or *OBSNUC or DEP	*CC
ii.	Onset tested (*word*)	[fɹ] *frank*	[sk] *skate*	[st] *stay*	[sp] *speak*
	Constraint to be ranked low	*CC	*CC	*OBSNU	*CC
iii.	Onset tested (*word*)	[sm] *smoke*	[skɹ] *scratch*	[spl] *split*	[spɹ] *spring*
	Constraint to be ranked low	*CC	*CC	*CC	*CC

b. Preferred constraint rankings for coda clusters

i.	Coda tested (*word*)	[nt] *rent*	[mp] *camp*	[ŋk] *frank*	[ns] *hence*
	Constraint to be ranked low	*CC or *OBSNUC	*CC or *OBSNUC	*OBSNUC	*CC
ii.	Coda tested (*word*)	[nz] *bronze*	[ndʒ] *range*	[ntʃ] *inch*	[kt] *fact*
	Constraint to be ranked low	*CC or *OBSNUC	*CC	*CC	*CC

iii.	Coda tested (*word*)	[pt] *kept*	[st] *east*	[ft] *lift*	[sp] *lisp*
	Constraint to be ranked low	*ObsNuc	*CC	*CC	*CC
iv.	Coda tested (*word*)	[sk] *ask*	[ts] *eats*	[dz] *AIDS*	[ps] *lapse*
	Constraint to be ranked low	*CC	*CC	*CC or Max	*CC
v.	Coda tested (*word*)	[fs] *puffs*	[lt] *melt*	[lk] *milk*	[lp] *help*
	Constraint to be ranked low	*CC	*CC or *ObsNuc	*CC	*ObsNuc
vi.	Coda tested (*word*)	[ls] *else*	[lʃ] *Welsh*	[lf] *self*	[lv] *shelve*
	Constraint to be ranked low	*CC or *ObsNuc	*ObsNuc	*CC or *ObsNuc	*CC

Based on (6-58), the probability each of the constraint rankings in (6-57) is preferred can be summarized as (6-59).

(6-59) The frequency each constraint ranking is most favorably perceived

Lowest ranked	*CC	Max	Dep	*ObsNuc
Onset position	91.7%	0%	8.3%	16.7%
Coda position	83.3%	4.2%	0%	41.7%

Generally, the StdE ranking (where *CC is lowest ranked) is still most acceptable to the Guangzhou people, for 91.7% of the standard onset forms and 83.3% of the standard coda forms receive the highest score. Considering that the E-grammar of GZE also preserves consonant clusters in most conditions (cf. 6-56-a), this finding is unsurprising. Of particular relevance to the ETT are the following consistencies between GZE and the desired grammar of the Guangzhou people.

Firstly, in terms of position, the Guangzhou people seldom favor the modifications to onset clusters but do show acceptance to the modifications in coda. Such positional asymmetry is in agreement with the lower stability of coda clusters in GZE (cf. 6-56-b).

Secondly, among the different ways to modify coda clusters, the Guangzhou people prefer violating *ObsNuc (preferred probability: 41.7%), a constraint that is also frequently violated in GZE to satisfy *CC]σ or *CODAOBS (cf. 6-56-d). For several tested words (e.g. *kept*, *frank*, and *Welsh*), the phonetic variant that violates *OBSNUC receives even significantly higher score ($p < 0.05$) than the StdE variant.

As another modification strategy in GZE, the deletion triggered by OCP[COR] is not high scored. This is probably because, as has been argued in §5.3 (pp. 98-99), segment deletion can lead to lexical ambiguity. Consonant deletion hence has a weaker tethering power when there is another modification strategy in the E-language that better ensures communication intelligibility (in this case obstruent syllabification).

If the StdE ranking is the only target grammar for the English learners in Guangzhou, one would not expect the Guangzhou people to accept a grammar that avoids coda clusters by violating *OBSNUC. Considering the accentuation of postvocalic obstruents observed in GZE (e.g. the spectrograms in (6-14) and (6-16)), the attitudinally accepted *CC]σ >> *OBSNUC ranking is very likely from GZE, a variety widely spoken and heard in the Guangzhou people's learning environment. Also, from a probability point of view, the frequency the Guangzhou people prefer the *CC]σ >> *OBSNUC ranking is 41.7%, which is very close to the actual frequency GZE violates *OBSNUC in coda position (40%; four out the 10 I-grammars violate *OBSNUC to prevent coda clusters). It is therefore reasonable to believe that the accepted *CC]σ >> *OBSNUC ranking is a reflection of the E-grammar of GZE.

To conclude, there are two possible target grammars for the English learners in Guangzhou, shown below.

(6-60) (a) MAX, DEP, *OBSNUC >> *[σCC, *CC]σ
(b) MAX, DEP, *CC]σ >> *[σCC, *OBSNUC

Besides the StdE ranking in (6-60-a), the Guangzhou people also accept (6-60-b) which falls within the E-grammar of GZE. Such alignment between the learners' target grammar and the local E-grammar constitutes another support for the ETT, in addition to the findings in the Hong Kong study (cf. §5.3).

6.4 Evidence outside cluster acquisition

Similar to the Hong Kong study, the alignment between the E-grammar of GZE and the Guangzhou people's preferred grammar is reflected also by the devoicing of final obstruents, a phenomenon occurs extensively in GZE.

From the 10 I-languages in the production test, a tendency to neutralize the voicing contrast in final obstruents is observed. For examples, *lend* is produced as [lent^{h}]; *range* as [ɹenitʃ]; *bled* as [blet^{h}]; *encourage* as [in.kʌ.ɹitʃ].[11] In these examples, final voiced obstruents are replaced by their voiceless counterparts, and the replacement happens both to singleton obstruent codas and to coda clusters. To give an overall picture, (6-61) on page 143 shows, across the 10 informants, whether or not final obstruent devoicing occurs.

In (6-61), the neutralization of final voicing contrast is found in nine out of the 10 Guangzhou informants. Among the nine individuals, neutralization is more common in final stops than in final fricatives and affricates, since two speakers only devoice final fricatives and affricates. A possible reason, pointed out in §5.4, is that the contrast for final stops can be maintained either through voicing or through aspiration, whereas the contrast for fricatives and affricates relies on voicing.

The extensive final devoicing in (6-61) resembles the neutralization of final voicing contrast in HKE (cf. 5-82) and can be captured by the same constraint ranking, presented below.

(6-62) IDENT[Voice,ONS] >> VOICED OBSTRUENT PROHIBITION (VOP) >> IDENT[Voice]

Given the concurrence of devoicing and non-devoicing in GZE, (6-62) coexists in the E-grammar with the StdE ranking which preserves final voicing contrast. The E-grammar of GZE thus includes both of the following constraint rankings.

(6-63) Constraint rankings in E-grammar of GZE

a. The StdE ranking which preserves final voicing contrast
   IDENT[Voice,ONS], IDENT[Voice] >> VOP
b. The ranking which leads to final obstruent devoicing
   IDENT[Voice,ONS] >> VOP >> IDENT[Voice]

---

[11] The fact that words such as *lending* and *encouraging* surface as [len.diŋ] and [in.kʌ.ri.dʒiŋ] proves the existence of devoicing, following the *–ing* suffix test introduced in Chapter 5, Note 18.

(6-61) Final obstruent devoicing across the 10 Guangzhou informants

Informants	Final obstruent devoicing occurs or not	If devoiced, final voiced stops surface as:	Final voiceless stops surface as:	If devoiced, final voiced fricatives and affricates surface as:	Final voiceless fricatives and affricates surface as:
GZ-F-22-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-F-22-02	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-F-23-02	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-M-20-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-M-21-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-M-24-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-M-25-01	Yes	Voiceless aspirated	Voiceless aspirated	Voiceless	Voiceless
GZ-F-23-03	Yes for fricatives and affricates	N/A	Voiceless aspirated	Voiceless	Voiceless
GZ-M-19-01	Yes for fricatives and affricates	N/A	Voiceless aspirated	Voiceless	Voiceless
GZ-F-23-01	No	N/A	Voiceless aspirated	N/A	Voiceless

If the E-tether is right, the Guangzhou people should accept not only the StdE ranking in (6-63-a), but also the ranking in (6-63-b). To test this prediction, the 66 Guangzhou participants in the language attitude test (cf. §6.3) also made preference judgments in a 5-point scale to phonetic variants that either preserve final voiced obstruent (e.g. [lend] for *lend*) or devoice final obstruent (e.g. [lent^h] for *lend*) (cf. §5.4, page 103, for the introduction to the test; see Appendix 5 for the list of stimuli).

Based on the mean score of each variant (see Appendix 7-B), (6-64) shows, for all tested words, the probabilities the non-devoiced variants and the devoiced variants are attitudinally preferred. Like §5.4, the percentages in (6-64) include both the highest-scored variants and those statistically similar, following a one-way ANOVA test ($p = 0.05$).

(6-64) The frequency each variant is preferred

Non-devoiced forms (corresponds to 6-63-a)	70%
Devoiced forms (corresponds to 6-63-b)	90%

It is clear in (6-64) that, as opposed to the non-devoiced forms, the devoiced forms are more likely to be favored by the Guangzhou people. The ranking in (6-63-b) hence enjoys higher acceptability than the StdE ranking does. Without recognizing the tethering effect of the local E-grammar, one would find it difficult to explain why the Guangzhou people prefer a grammar that requires final devoicing over the StdE grammar. For this reason, final devoicing adds as another case showing the applicability of the ETT in Guangzhou.

6.5 Summary

The ETT is validated in this chapter through the identification of the Guangzhou people with the E-grammar of GZE.

The identification is first reflected in the Guangzhou people's acceptance of syllabic obstruents. Based on the generalization of 10 GZE I-grammars, obstruent syllabification is found to be frequently employed in the E-grammar of GZE to avoid unwanted coda clusters. Expressed through OT, obstruent syllabification requires the inclusion of the following constraint ranking in the E-grammar: *CC]σ >> *OBSNUC. Interestingly, the *CC]σ >> *OBSNUC ranking is attitudinally accepted by the Guangzhou people, evidenced by the language attitude test implemented to 66 Guangzhou participants. Such acceptability of a "non-standard" local grammar verifies the tethering effect predicted by the ETT.

It is also observed in the E-language that final obstruent devoicing abounds in GZE, describable through the constraint ranking IDENT[Voice,ONS] >> VOP >> IDENT[Voice]. In the language attitude test, this ranking receives even higher degree of preference than the StdE ranking where final voicing contrast is maintained. The positive attitudes towards final obstruent devoicing further confirm the force of attraction GZE imposes on the Guangzhou people.

Chapter Seven

Towards a General Theory of the Bottleneck

This chapter explores the E-tether Theory (ETT) as a general theory for the bottleneck effect in L2 acquisition. The empirical aspect of this generality is discussed in §7.1 by a wide-angled view comparing the applicability of the ETT in the two speech communities (Hong Kong and Guangzhou) reported in Chapters Five and Six.

The generality of the ETT is further supported by its compatibility with other accounts of L2 bottlenecks. §7.2 to §7.4 present how the ETT subsumes some of the key ideas of existing acquisition theories while being compatible with others. §7.2 takes a stab at how the ETT offers an encompassing account that includes L1 transfer effects on the one hand and UG markedness on the other; §7.3 demonstrates how the ETT complements the Critical Period Hypothesis; §7.4 explains how the ETT captures the insights of Behaviorism in a way that is compatible with current understanding of UG. In §7.5, the possibility of extending the ETT to the aspects other than phonology is discussed, followed by a summary in §7.6.

7.1 The empirical generality of the E-tether Theory

The generality of the ETT is evaluated in this section by comparing its applicability in Hong Kong and in Guangzhou, two cities with different language environments (cf. §1.5). Drawing evidence from Chapter Five and Six, this is done through a comparison on the Hong Kong people and the Guangzhou people’s degree of acceptance towards the L2 E-language of their respective communities.

To describe such degree of acceptance, (7-1) first presents the cluster repairing strategies which recurrently appear in the E-language of Hong Kong English (HKE) and the repairing strategies accepted by the Hong Kong people in the language attitude test (cf. §5.3). Similarly, (7-2) shows the repairing strategies in the E-language of Guangzhou English (GZE) and those attitudinally accepted by the Guangzhou people (cf. §6.3). To grasp the major patterns, the tables “Repairing strategies in the E-language of HKE/GZE” in (7-1) and (7-2) list only the strategies found in more than one I-language out of the total 10; accordingly, the tables "Repairing strategies accepted by the Hong Kong/Guangzhou people" show only those whose frequency of being preferred is higher than 10%. The strategies observed in only one I-language are not listed because they are individual phenomena rather than the common properties of the E-language. The identical strategies in the two tables are linked by the arrows.

(7-1) HKE patterns and the Hong Kong people's attitudinally accepted patterns

	Repairing strategies in the E-language of HKE			**Repairing strategies accepted by the Hong Kong people**	
	Description	Frequency in the 10 I-languages		Description	Frequency of being desired
a.	Devoicing of final obstruents	(9/10)	⟷	Devoicing of final obstruents	80%
b.	Syllabic [s] in /s/-stop onsets	(2/10)	⟷	Syllabic [s] in /s/-stop onsets	66.7%
c.	Obstruent syllabification in coda clusters	(3/10)	⟷	Obstruent syllabification in coda clusters	33.3%
d.	Deletion of the stop in homorganic coda clusters	(4/10)	⟷	Deletion of the stop in homorganic coda clusters	14.3%

(7-2) GZE patterns and the Guangzhou people's attitudinally accepted patterns

	Repairing strategies in the E-language of GZE			**Repairing strategies accepted by the Guangzhou people**	
	Description	Frequency in the 10 I-languages		Description	Frequency of being desired
a.	Devoicing of final obstruents	(9/10)	⟷	Devoicing of final obstruents	90%
b.	Obstruent syllabification in coda clusters	(4/10)	⟷	Obstruent syllabification in coda clusters	41.7%
c.	Syllabic [s] in /s/-stop onsets	(4/10)	⟷	Syllabic [s] in /s/-stop onsets	16.7%
d.	Deletion of the stop in homorganic coda clusters	(4/10)	⟷	Deletion of the stop in homorganic coda clusters	14.3%

In (7-1), the table on the left tells that four cluster repairing strategies emerge in the E-language of HKE. The table on the right indicates that the Hong Kong people have shown acceptance to four repairing strategies in the language attitude test, all of which fall within the range of the E-language (shown by the arrows). It should be noted that the data presented in the two tables are from two independent tests (one from production test and the other from language attitude test), the co-occurrence of the strategies in the two tables thus suggests a general correspondence between the Hong Kong people's accepted patterns and the E-language of HKE. Nonetheless, as can be seen from the table on the right, the degrees the different strategies are attitudinally desired are unequal. Compared with final obstruent devoicing (7-1-a) and obstruent syllabification (7-1-b and 7-1-c), the desired percentage of the deletions to homorganic coda clusters (7-1-d) is considerably lower. A possible explanation, as mentioned in §5.3, is that segment deletion can produce severer loss of lexical information as opposed to syllabic obstruents or final devoicing, and hence has a weaker tethering effect.

(7-2) presents the relation between the E-language of GZE and the Guangzhou people's accepted cluster repairing strategies. In the E-language of GZE, there are four repairing strategies to consonant clusters. In the language attitude test, four strategies receive a desired frequency higher than 10%, and the four all have correspondence in the actual E-language. Similar to the Hong Kong study, the deletions to homorganic coda clusters (7-2-d) are less favorable, which may reside in their damage to lexical information. Notably, compared with the Hong Kong study, the Guangzhou people's degree of acceptance to the syllabic [s] in /s/-stop onsets (7-2-c) is much lower (16.7%, as opposed to the 66.7% in Hong Kong).

Based on (7-1) and (7-2), one can then compare to what extent the Hong Kong people and the Guangzhou people accept the E-language of their respective communities. In coda position, the people in the two cities do not have big difference regarding the acceptability of the local E-language, though the Guangzhou people slightly more tolerate GZE than the Hong Kong people to HKE (the desired frequency of final obstruent devoicing is 90% in Guangzhou and 80% in Hong Kong; the desired frequency of the syllabic obstruents in coda is 41.7% in Guangzhou and 33.3% in Hong Kong). In onset position, the Hong Kong people show significantly higher preference for the local E-language than the Guangzhou people do, reflected by the much higher acceptability of the syllabic [s] to the Hong Kong people than to the Guangzhou people (66.7% vs. 16.7%). The difference between the two cities in the acceptability of the local E-language implies that the ETT may operate better in Hong Kong than in Guangzhou.

The better applicability of the ETT in Hong Kong may result from the indigenization of English in Hong Kong. English has been used as an official language in Hong Kong for more than a century (Setter et al. 2010:104) and is used more widely in Hong Kong than in Guangzhou, reflected by Kachru's (1985) "Three-Circle" division where Hong Kong belongs to the "Outer Circle" and Guangzhou belongs to the "Expanding Circle". Based on the history of using English and the width of its use, English is therefore more likely to be indigenized in Hong Kong and be incorporated into the linguistic identity of the Hong Kong people. Considering that syllable onset is perceptually more prominent than coda, it is a position where the indigenized features are liable to be produced, which in turn leads to the different attitudes of the Hong Kong people and the Guangzhou people toward onset clusters.

This however never means that the ETT does not work in Guangzhou, because the Guangzhou people's acceptance toward final obstruent devoicing and the obstruent syllabification in codas (shown in (7-2-a) and (7-2-b)) would be hard to explain if the Standard English (StdE) is the only target for L2 acquisition, but can be easily resolved by the E-tether in the ETT. Hence, though the effect of the ETT may vary depending on how indigenized the L2 is, it still has the potential as a general theory capturing the acquisition in different social environments.

When taking into account previous language attitude studies (cf. §2.6), evidence in support of the ETT can be further found in a range of language learning contexts. In these studies, speakers' acceptance towards the local variety has been documented, summarized as (7-3).

(7-3) Different communities' acceptance towards the local variety (arranged in chronological order)

Speaker groups	**Accepted local varieties**	**Examples**
College-educated English speakers in India	Indian English	Kachru (1976)

Adolescents in Brazil	The English spoken by Brazilians	El-Dash & Busnardo (2001)
Secondary school students in Singapore	Colloquial Singaporean English	Tan & Tan (2008)
University students in Japan	Japanese accented English	McKenzie (2010)
University students in Hong Kong	Educated HKE	Zhang(2010); Sewell (2012)
Secondary school students in Malaysia	Malaysian English	Pilus (2013)

Despite living in geographically and linguistically different areas, the speaker groups in (7-3) all show identifications with the local variety. These findings, together with the Hong Kong and the Guangzhou study, consolidate the empirical generality of the ETT.

The generality of the ETT also resides in its ability to complement the existing theories on the bottleneck problem (cf. §1.1) so that a more comprehensive understanding of L2 acquisition can be obtained. How the ETT is incorporated with other theories will come in the following sections.

7.2 L1 transfer & markedness

As is discussed in §2.2 and §2.3, the bottleneck in L2 acquisition can be directly triggered by linguistic internal factors such as L1 transfer and marrkedness. Both of the two factors are compatible with the ETT, by virtue of the inclusion of the dimension of I-language in the theory, shown below.

(7-4) Dimension of I-language

$I_{INITIAL}$ I_1 I_2 I_3 … I_{n-1} I_n I_{n+1} I_{TL}

In this dimension, the only focus is the development of L2 I-grammars, denoted by the I-grammar states in (7-4). This development starts with an initial state which can either be the L1 or the default state of UG,[1] and progresses towards the target language (TL) grammar. Without taking into account the influence from the external environment (i.e. the E-language), the I-language development mainly needs to overcome the hurdles from the existing L1 knowledge and the UG markedness.

To demonstrate the ability of the ETT in describing L1 transfer and markedness, (7-5) shows, through a constraint demotion route of the HKE I-grammars (cf. (5-70)), how L1 transfer and markedness figure in the dimension of I-language.

(7-5) A constraint demotion route of the HKE I-grammar

Stage I: *[σCC, OCP[PLACE] >> MAX

⇩ demoting *[σCC

Stage II: OCP[PLACE] >> MAX >> *[σCC

⇩ demoting OCP[PLACE]

Stage III: MAX >> OCP[PLACE], *[σCC

The constraint demotions in (7-5) first display the role of markedness, because the demoted constraint in each learning step is markedness in nature. The influence from the L1 can also be seen in (7-5), since the demotions from the Stage I to the Stage III present a gradual departure from the L1 grammar. In Stage I, for example, the *[σCC >> MAX ranking transferred from the L1 will lead to the consonant deletion in complex onsets. The transfer and the markedness effects found in the I-languages, together with the E-tether discovered from the learners' language attitudes, jointly form the causes of the bottleneck in L2 acquisition.

7.3 Critical Period Hypothesis

The bottleneck can also be related to age. It is common that adult learners struggle in L2 learning while children master their L1 with ease. The notion of critical period was raised as a biological account for this phenomenon. Penfield & Roberts (1957:237-240) contends that child's brain has a special capacity for

[1] The initial state follows from the finding in §6.1.6 that Guangzhou English speakers may on the one hand start L2 learning at a point even lower than the L1 Cantonese grammar, but on the other hand preserve certain properties that can only be explained by L1 but not the default UG state.

language learning which makes direct learning from input possible, and that there is a biological clock in the brain, turning off the innate capacity after certain age. Lenneberg (1967:175) argues that the innate biological predisposition shuts down with the eventual hemispheric lateralization, around the age of puberty. After the abrupt closure, learners lose the innate ability to fully acquire a language. Therefore, he regards the years from age two to puberty as the critical period for language acquisition.

The Critiacal Period Hypothesis (CPH) is certainly powerful in explaining the non-native-like competence of adult L2 speakers. Patkowski (1980), Johnson & Newport (1989) and DeKeyser (2000), for example, find that young learners reach higher level of L2 attainment than adult learners. The CPH, nonetheless, may have difficulty in dealing with the reported cases where adult learners successfully master an L2. An oft-cited example is Joseph Conrad, a native Polish speaker who eventually became a prominent writer in English. In both phonology and morphosyntax, the native-like command of adult L2 learners has also been widely documented (e.g. Oyama 1973; Birdsong 1992, 2007; Van Wuitswinkel 1994; Bongaerts 1999).

By incorporating the CPH with the ETT, the success of L2 learners can then be accounted for. Firstly, the native-like competence is explainable in the ETT through the change in social environment. It is possible that learners shift to a native community of the TL and accommodate to the new E-language, evidenced by the boost on learning brought by language immersion programs (e.g. Fathman 1978; Gass 1987; Dussias & Sagarra 2007; cf. §2.4). As Lightbown & Spada (2006:73) puts it, adults can make “rapid progress towards mastery of a second language in contexts where they use the language in social, personal, professional, or academic interaction”. Ioup, Boustagui, El Tigi & Moselle (1994), for example, shows that a native-like competence of Arabic is attainable by an adult learner who immigrated from Britain to Egypt and used Arabic regularly in daily life, even without the help of formal instruction. Secondly, even if the learners stay in a non-native environment, a native-like competence is still possible in the ETT. Recall that in the ETT the development of I-grammar is also prompted by the linguistic input from the TL (cf. §1.4.1). Such input-triggered learning may sometimes overcome the E-tether and push I-grammars towards the TL state, as long as sufficient amount of input is received from the TL. A suitable is the L2 learners attending international schools and taught by native speakers. Their exposure to the TL input can be the key for them to reach the TL competence.

The ETT thus provides complements to the CPH so that both native-like and non-native-like competence of adult L2 learners become understandable.

7.4 Behaviorism

The emphasis of the ETT on social environment is in a certain sense compatible with Behaviorism (e.g. Skinner 1957), a psychological theory that views learning as the consequence of the stimuli from the learners' surrounding environment.

In Behaviorism, language learning is realized through the formation of habits. Such formation primarily relies on the *stimuli* (the linguistic input) from the external environment which lead to the learners' linguistic *responses* (usually manifested as the reproductions or imitations of the linguistic input). The responses are then subject to positive or negative *reinforcements* from the environment: correct utterances are reinforced by approval or successful communication; incorrect utterances are impeded by lack of reward (Rivers 1968:73). The reinforcement process will continue until the correct linguistic habits are formed.

Regardless of whether language learning is merely the product of stimuli, responses and reinforcements, the importance Behaviorism gives to environment is consistent with the well-acknowledged impacts of social contexts on L2 acquisition (cf. §2.4) and is an aspect Behaviorism and the ETT are in common. In the ETT, the input from the local E-language is comparable in effect with the stimuli from the surrounding environment. The I-grammars in a community approximate towards the local E-grammar because they receive the input from that E-language; similarly, in Behaviorism individuals develop a certain set of linguistic habits because of the stimuli from their environment. The sense of identity, which contributes to the formation of the E-tether, also has similar effect with the reinforcement in Behaviorism. When individuals conform to the speech norms of their community, they will be accepted as community members and their sense of belonging will grow, which is analogous to the positive reinforcement. When individuals deviate from the local speech norms, the deviation may be regarded as a betrayal, similar to the negative reinforcement in Behaviorism. For example, Nigerians who speak like a native speaker of English will be viewed by their countrymen as snobbish (Bamgbose 1971:41). This effect can both be interpreted in the ETT and in Behaviorism. In sum, the parallels between Behaviorism and the ETT can be shown as (7-6).

(7-6) Parallels between Behaviorism and the ETT

Behaviorism		**E-tether Theory**
Stimuli from the surrounding	≈	Input from the local E-language
Positive reinforcement	≈	The sense of belonging
Negative reinforcement	≈	The feeling of betrayal

While compatible with the insights from Behaviorism, the ETT is certainly founded on UG, because the I-grammars in the ETT are never blank slates but represented as the innate constraints from UG, and because the development of the I-grammars follows the learning mechanisms in UG. The simultaneous compatibility of the ETT with UG and with Behaviorism suggests that various learning theories are not necessarily competing, but can be incorporated with one another. As is pointed out by Menezes (2013), L2 acquisition is a complex system, with each school of theory capturing a certain aspect of it. An amalgamation of different theories, such as what the ETT does, will give a broader understanding of how different factors interact in the process of acquisition.

7.5 Going beyond phonology

As the final point on the generality of the ETT, it should be noted that the Hong Kong and the Guangzhou studies in Chapter Five and Six, as well as most of the prior attitudinal studies relevant to the ETT, focus on phonology. Relatively few investigations have been made in the other aspects of L2 acquisition (e.g. syntax, lexicon, or writing). Based on the available evidence, this section demonstrates the possibility of applying the ETT to the domains other than phonology.

The first piece of evidence is from syntax. Walter (2011), through the acquisition of German pronouns by native English speakers, finds that the L2 learners show more acceptance to the non-standard German forms which are consistent with the grammar of English, than to the standard German forms. Unlike English, German specifically uses demonstrative personal pronouns (e.g. *der*) to refer back to the antecedent which is the object of the previous clause;

elsewhere, regular personal pronouns (e.g. *er*) are used. The distinction between regular personal pronouns (PER) and demonstrative personal pronouns (DEM) can be demonstrated through the examples in (7-7-a) and (7-7-b).

(7-7) Regular personal pronouns and demonstrative personal pronouns as anaphora (Walter 2011:4)

a.

Hans	*wollte*	*mit*	*Jan*	*spielen,*	*aber*	***er***	*war*	*krank.*
Hans	wanted	with	Jan	to play	but	he-PER	was	sick.

"Hans wanted to play with Jan, but he was sick."

b.

Hans	*wollte*	*mit*	*Jan*	*spielen,*	*aber*	***der***	*war*	*krank.*
Hans	wanted	with	Jan	to play	but	he-DEM	was	sick.

"Hans wanted to play with Jan, but he was sick.

Legend: "PER" – Regular personal pronouns
"DEM" –demonstrative personal pronoun

According to Bosch, Katz & Umbach (2007), native speakers of German would find (7-7-a) ambiguous because the regular personal pronoun *er* does not make clear as to whether it refers to the subject *Hans* or the object *Jan* of the first clause, though the subject is more likely to be the antecedent. In contrast, the demonstrative pronoun *der* in (7-7-b) is a clear indication that it refers to the object *Jan*. Such division of personal pronouns is apparently different from English which has no specific pronoun to refer to the object of a previous clause. Instead, English relies more on syntactic structures or discourse to resolve ambiguous pronouns.

To examine whether the German demonstrative personal pronouns are acceptable to the L1 English L2 German speakers in the United States, Walter (2011) collected the grammaticality judgments of nine L2 German speakers towards the German demonstrative personal pronouns which are all correct. The results show that, for more than half of the speakers, the acceptability rate of the German demonstrative personal pronouns is lower than 50%. In other words, more than half of the L2 German speakers preferred a grammar without demonstrative personal pronouns, the same way as the English grammar they have been used to. The better acceptability of a non-standard grammar as opposed to the standard grammar coincides with the prediction of the ETT.

Another piece of evidence is from the L2 acquisition of English collocations, namely, the regular combinations of words to form fixed expressions, e.g. *touch base*/*make contac*t vs. **touch contact* ("*" indicates ungrammatical). Hanamoto (2013) reports that there a tendency for the L2 English learners in Japan to produce collocations which may be regarded by the native speakers of English as inappropriate (such as the *touch contact* shown above). To assess whether the "non-standard" collocations in Japanese English (JE) are acceptable or are treated as errors by native speakers of English and by the L2 English learners in Japan, Hanamoto (2013) selected 15 typical "non-standard" verb+noun combinations from a corpus of JE, and asked 21 native speakers of English and 42 Japanese learners of English to make acceptability judgments on the JE collocations. It turned out that the Japanese learners of English exhibited a higher degree of acceptance toward the JE collocations than the native speakers did – out of the 15 tested items, though three received higher acceptability ratings from the native speakers than from the Japanese learners of English, the L2 learners in Japan gave higher acceptability ratings to seven items than the native speakers did.

The two studies presented in this section both suggest the acceptability of the local grammar to L2 learners. Such acceptability is found not only in phonology, but also in syntax and in lexical combinations. This implies the potential of applying the ETT to different aspects of L2 acquisition.

7.6 Summary

This chapter discusses the ETT as a general theory capturing the bottleneck in L2 acquisition. Through a comparison of the suitability of the ETT in different learning environments, the theory is found to be applied to a range of social environments, though its effectiveness may vary depending on how indigenized the L2 is in a given society. The empirical generality of the ETT also lies in its capability in accounting for different aspects of L2 acquisition. It holds not only for phonological acquisition, but also for the acquisition of syntax and lexis. The ETT thus has the promise of being a theory explaining the acquisition in different social contexts and for different domains of L2.

The generality of the ETT is reflected also in its compatibility and complement to other acquisition theories, because it takes into account both the cognitive and the affective aspects of L2 acquisition. Due to the recognition of the central role of I-grammars, L1 transfer and UG markedness are expressible in the ETT through the rankings of universal constraints and through how the rankings rearrange in the course of L2 acquisition. Also, by resorting to the impacts of social environment on I-grammars, the ETT complements the existing acquisition theories. For instance, the native-like competence of adult L2 learners, which would form a challenge to the Critical Period Hypothesis, would become explainable in the ETT through the change in social environment. Similarly, the stimuli and the reinforcements in Behaviorism can be understood in the ETT in terms of the linguistic input and the sense of identity, in a way compatible with UG.

Chapter Eight
Conclusion and Implications

8.1 Conclusion

The E-tether Theory (ETT) is a model that captures the stagnation of L2 development. It argues that the development of L2 I-grammar (individual's mental grammar) is attracted by the L2 E-grammar (the grammar of a speech group) of the speaker's community. Such attraction, called the "E-tether", is the crux of the stagnation. When the E-grammar of the learner's community is not identical to the target language (TL), the E-tether will prevent the progression towards the TL. By resorting to the tethering effect of the non-native variety spoken in a learner's speech community, the ETT gives a new account for the bottleneck problem in L2 acquisition. It also shows that such interaction between a learner and the external environment is describable by generative theories.

The ETT takes into account both the roles of I-language and E-language in L2 acquisition. Accordingly, the E-tether, which is the central component of the ETT, functions as the key that links I-language with E-language. The E-tether has both cognitive and affective grounds. From a cognitive perspective, the E-tether can be due to the linguistic input provided by the E-language of the learner's community (i.e. $E_{COMMUNITY}$). Since $E_{COMMUNITY}$ constitutes a big proportion of input data, it inevitably affects the outcome of grammar learning. From an affective perspective, the E-tether can stem from the learner's identification with his/her community, which in turn is driven by the desire for recognition, affiliation and security (Norton 2000:8). The Intergroup Model (Giles & Byrne 1982), for example, contends that the learners who identify strongly with their L1 community will have little incentive to approximate the TL. Instead, they may accentuate ethnic speech markers or even create their own distinctive ethnolinguistic variety.

The ETT not only has theoretical grounds, but also gains empirical support. This is clearly shown through the acquisition of English consonant clusters by the native Cantonese speakers in Hong Kong and in Guangzhou. In the L2 E-language of the Hong Kong community and of the Guangzhou community, there is a strong tendency to produce syllabic obstruents and to devoice word-final obstruents. Such E-language patterns, though different from the Standard English, are attitudinally accepted by the Hong Kong people and the Guangzhou people. If one does not recognize the role of $E_{COMMUNITY}$ in L2 acquisition, the L2 speakers' acceptance of the "non-standard" patterns would be hard to explain. In fact, empirical support for the ETT is not limited to the Hong Kong study and the Guangzhou study, nor is it limited to phonological acquisition. The positive attitudes of L2 speakers towards the local L2 variety are found, for example, also in the acquisition of English pronunciations by Brazilians (El-Dash & Busnardo 2001) and in the acquisition of German syntax by the native English speakers in the United States (Walter 2011), to list just a few.

The fact that L2 learners gravitate towards the E-language of their respective communities suggests that I-language and E-language are not two unrelated and irreconcilable entities. Instead, the I-language, which is based on Universal Grammar (UG), and the E-language within which I-languages situate in are in an interaction. The L2 I-languages in different external environments have certain commonalities (cf. White 2003b) because they are governed by the same principles from UG; the same UG develops into different L2s in different social contexts because it is tethered to different E-languages. This is perhaps best stated through an old Chinese proverb "橘生淮南則為橘,生於淮北則為枳". Translated into English, it says "The same seeds sown in geographically different areas can grow into fruits with different flavors".

8.2 Sociolinguistic and educational implications

With the establishment of the ETT, a question that follows would be, besides offering a new understanding of L2 acquisition, what sociolinguistic or educational implications it will bring.

From a sociolinguistic perspective, the E-tether serves to attract more new speakers for the emerging L2 variety in a community. An ultimate consequence of this is that it will facilitate the formation of new linguistic varieties. When there accumulates a critical mass of language users, a non-native variety may gradually become stabilized. This is particularly important for the study of new linguistic varieties, especially the study of World Englishes. Under the framework of the ETT, varieties like Indian English have become relatively stabilized because they have accumulated a large number of speakers under the help of the E-tether. Such accumulation can be a long process, spreading from a small group of English users at the earliest stage to the whole community, lasting for over a century. Though it is still controversial as to whether Guangzhou English (GZE) is a recognizable variety (see Bruthiaux 2003:168 for criteria to define a variety in the Expanding Circle), it is of little doubt that the Guangzhou people speak English with a Cantonese accent. When a growing number of English learners in Guangzhou are tethered to this accent, GZE may eventually develop into a recognized and stabilized variety in the future. A long-term result of the E-tether is that the same language may give rise to different varieties in different speech communities, thereby accelerating linguistic diversity.

The ETT also has implications on the interpersonal communication within a society, because, rather than impeding communication, $E_{COMMUNITY}$ can act as the facilitator of the interaction between L2 speakers, especially when intelligibility is taken into consideration. Evidence from intelligibility research has shown that non-native accents do not necessarily entail unintelligibility (Smith & Rafiqzad 1979; Smith 1992; Munro & Derwing 1995), running against the early claim that L2 speakers should be "free of any indication that the speaker is not a clinically normal native" (Griffen 1980, cited in Munro 2008:193). In the experiment of Smith & Rafiqzad (1979), for instance, native English speech (American English in this case) was always ranked among the least intelligible compared to non-native speech such as Indian English and Sri Lanka English by native English listeners and the L2 English listeners from different L1 backgrounds. Similarly, in a study on the intelligibility of native and non-native Dutch accents, van Wijngaarden (2001) observes that, for non-native listeners, the non-native accent with enough clarity is more intelligible than the native accent.

There is evidence further showing that $E_{COMMUNITY}$ enjoys intelligibility advantage. That is, L2 speakers tend to find the non-natives from the same L1 background at least as intelligible as native speakers, a phenomenon named as "matched interlanguage speech intelligibility benefit" (MISIB) (Bent & Bradlow 2003). As Bent & Bradlow (2003:1607) indicates, MISIB is based on the shared phonetic and phonological knowledge between the speaker and the listener. For the non-natives who share an L1, their shared linguistic knowledge covers the aspects of both the L1 and the TL; for the non-native/native pair, the shared knowledge includes only the knowledge of the TL insofar as it is developed in the non-native. The shared L1 also benefits intelligibility at a broader discoursal level. Sridhar & Sridhar (1992:101), for example, notes that "given that [L1] transfer features are not idiosyncratic to learners but shared by speakers with the same substratal languages, they serve as effective simplification strategies, modes of acculturation … and as markers of membership in the community". L1 transfer thus functions "as the grease to make the wheels of bilingual communication turn smoothly". As a result of the MISIB, $E_{COMMUNITY}$, which is affected by the shared L1 of the L2 speakers in a community, constitutes the most intelligible and possibly the most effective communication tool for those speakers. This will inevitably strengthen the unity of a speech community.

In recognition of the tethering effect and the potential advantages of $E_{COMMUNITY}$, the final educational dilemma we need to face is whether or not the trend of the E-tether should be prevented. The answer to this dilemma largely depends on whether the goal of L2 acquisition is to reach a stage comparable to the native speakers of the TL or to master a new tool of communication. If the goal of acquisition is to approximate a native model, the E-tether certainly will hinder this process. To prevent the E-tether, people need to set up international schools where teachers are from the native-speaking communities or to send L2 learners abroad to study in native environments. Simply following a native model, however, has been argued to be unrealistic and inappropriate (Kachru 1992:357; Kirkpatrick 2007:188). From a practical consideration, the extent to which the majority of the L2 speakers in non-native environments have direct access to native models would be in doubt. Macauley (1988) indicates that many (if not most) English teachers in the non-Inner Circle countries do not themselves speak a native variety, which would yield a paradoxical situation if a native model is imposed on students. In Kenya, for instance, very few native models are available in the school system. The English exposed to most Kenyans is the variety used in Kenya by Kenyans (Kioko & Muthwii 2001). In terms of appropriateness, a native model may not be the most suitable choice either. As is mentioned above, $E_{COMMUNITY}$ can even be more intelligible than native varieties to L2 speakers. In real communication, it is also found that "the culture-bound localized strategies of, for example, politeness, persuasion, and phatic communication transcreated in English are more effective and culturally significant than are the native strategies of interaction" (Kachru 1991:219). A native-like state of L2 acquisition is thus unnecessary.

If the goal of L2 acquisition is to master a new tool of communication, the E-tether may even promote learning, owing to the intelligibility advantage of $E_{COMMUNITY}$. According to the Input Hypothesis (Krashen 1982), L2 acquisition takes place through the access to comprehensible input. In other words, input contributes to L2 acquisition only if it can be understood, whereas the incomprehensible part is merely “noise” (p.63). The highly comprehensible $E_{COMMUNITY}$ therefore functions as a major contributor of meaningful input, and the E-tether is significant in this process as it leads learners towards the most comprehensive source of input. In this sense, it is perhaps more sensible to view the E-tether as a bliss rather than a curse to L2 learners.

8.3 Limitations and future recommendations

The present study proves the applicability of the ETT in Hong Kong and Guangzhou, but the experiments still have rooms for improvement in several aspects. Firstly, as is indicated in §4.5.2, the attitudinal statement “I like the way it is pronounced” can be interpreted in a number of ways. Though this statement enables one to test if there is preference for a particular phonological pattern, it fails to provide a detailed account for the preference. The second limitation, closely related to the first one, is that the subjects in the test are allowed to rate different pronunciation stimuli equally. Despite its usefulness in dealing with the variation in a language, the same preference rating to these stimuli may derive from different reasons. For example, one stimulus may receive full mark because of its pleasantness and another for its “standardness”. Thirdly, the 10 informants based on whom the E-grammar in each city is generalized may not represent the whole community. To fully describe the E-language patterns of the two cities, one ideally needs corpora which are built on the speech of a large number of speakers.

Given the above limitations of the present study, more subjects can be invited in the future to give a more comprehensive description of E-grammars. It is also meaningful to recruit participants from other age or educational groups or from different social classes, so as to probe into how the tethering effect varies according to these social variables. In multilingual contexts such as Singapore or India, a variable that deserves attention is the linguistic background of speakers, because the multilingual speakers in such communities are often heterogeneous in terns of their linguistic repertoire. As Lim (2007) points out, the emergent new linguistic variety in a community can be affected by the other languages present the community and the social dominance of these languages. A direction in the future is to investigate whether the linguistic background of speakers can affect the tethering effect.

It should be pointed out that the present study mainly deals with the acquisition taking place in non-native environments, since Hong Kong belongs to what Kachru (1985:366-367) terms as the “Outer Circle” where English has official functions, and Guangzhou to the “Expanding Circle” where the use of English is restricted mostly to educational contexts. What remains to see is the explanatory power of the ETT to the L2 learners in native environments. As is stated in §1.4.3, the E-tether is from the social network of learners, not simply the location. A suitable case to test the effectiveness of the ETT in native environments is the minority groups who learn the dominant language of a society, such as the Chinese communities in California who learn English. By investigating the attitudes of these learners towards the L2 used by their own community as opposed to the other varieties such as the Standard American English, one would be able to see whether the tethering effect applies to such communities.

Readers may also note that most of the L2 in question in this dissertation is English. This is unsurprising given the status of English as a global lingua franca, with 430 millions L2 speakers by 2003 (Crystal 2003:68; Jenkins 2015:2 suggests that the actual figure can even be more and may have further increased since 2003). Studying the acquisition of English is thus convenient and caters the needs of a large number of learners. Though it is shown in §7.5 that the ETT works for the acquisition of German in the United States, more evidence from the acquisition of other languages is needed to test whether the ETT is a universal theory that suits not only English. It is suggested that future studies explore the acquisition of both those major languages such as Chinese or French and those that are internationally less-used such as Javanese or Tagalog. This will ultimately contribute to a more profound understanding on how the ETT operates in different social environments and for learners of different languages.

References

Abu-Rabia, Salim (1997) Gender differences in Arab students' attitudes toward Canadian society and second language learning. *The Journal of Social Psychology*, 137, 125-128.

Anderson, Janet I. (1987) The markedness differential hypothesis and syllable structure difficulty. In Geogette Ioup & Steven H. Weinberger (eds.), *Interlanguage phonology: The acquisition of a second language sound system*, 279-291. Rowley, MA: Newbury House.

Archangeli, Dianna (1999) Introducing optimality theory. *Annual Review of Anthropology*, 28, 531-552.

Bagemihl, Bruce (1995) Language Games and Related Areas. In John Goldsmith (ed.), *The Handbook of Phonological Theory*, 697-712. Malden, MA: Blackwell.

Bamgbose, Ayo (1971) The English language in Nigeria. In John Spencer (ed.), *The English language in West Africa*, 35-48. London: Longman.

Battistella, Edwin L. (1996) *The logic of markedness*. New York: Oxford University Press.

Bauer, S. Robert & Paul K. Benedict (1997) *Modern Cantonese phonology*. Berlin: Mouton de Gruyter.

Beddor, Patrice S., & Winifred Strange (1982) Cross-language study of perception of the oral-nasal distinction. *Journal of the Acoustical Society of America*, 71, 1551-1561.

Beebe, Leslie M. & Howard Giles (1984) Speech accommodation theory: A discussion in terms of second-language acquisition. *International Journal of Sociology of language*, 46, 5-32.

Beebe, Leslie M. (1985) Input: Choosing the right stuff. In Susan M. Gass & Carolyn G. Madden (eds.), *Input in second language acquisition*, 404-414. Rowley, MA: Newbury House.

Beebe, Leslie M. (1988) Five sociolinguistic approaches to second language acquisition. In Leslie M. Beebe (ed.), *Issues in second language acquisition: Multiple perspectives*, 43-77. New York: Newbury House.

Beinhoff, Bettina (2013) *Perceiving identity through accent: Attitudes towards* *non-native speakers and their accents in English*. Oxford: Peter Lang.

Benson, Bronwen (1986) The markedness differential hypothesis: Implications for Vietnamese speakers of English. In Fred R. Eckman, Edith A. Moravcsik & Jessica R. Wirth (eds.), *Markedness*, 271-290. New York: Plenum Press.

Bent, Tessa & Ann R. Bradlow (2003) The interlanguage speech intelligibility benefit. *Journal of the Acoustical Society of America*, 114, 1600-1610.

Best, Catherine T., & Winifred Strange (1992) Effects of phonological and phonetic factors on cross-language perception of approximants. *Journal of Phonetics*, 20, 305-330.

Birdsong, David (1992) Ultimate attainement in second language acquisition. *Language*, 68, 706-755.

Blevins, Juliette (1995) The Syllable in Phonological Theory. In John Goldsmith (ed.), *The Handbook of Phonological Theory*, 206-244. Malden, MA: Blackwell.

Bley-Vroman, Robert (1990) The logical problem of foreign language learning. *Linguistic Analysis*, 20, 3-49.

Boersma, Paul (1997) How we learn variation, optionality, and probability. *Proceedings of the Institute of Phonetic Sciences of the University of Amsterdam*, 21, 43–58.

Boersma, Paul (1998) *Functional phonology: Formalizing the interactions between articulatory and perceptual drives*. PhD dissertation, University of Amsterdam.

Boersma, Paul (2000) Learning a grammar in Functional Phonology. In Joost Dekkers, Frank van der Leeuw & Jeroen van de Weijer (eds.), *Optimality theory: phonology, syntax, and acquisition*, 465-523. Oxford: Oxford University Press.

Boersma, Paul & Bruce Hayes (2001) Empirical tests of the gradual learning algorithm. *Linguistic Inquiry*, 32, 45–86.

Boersma, Paul & David Weenink (2013) Praat: doing phonetics by computer (Version 5.3.59) [Computer program]. Retrieved on November 20, 2013, from http://www.praat.org/

Bolton, Kingsley & Helen Kwok (1990) The dynamics of the Hong Kong accent: Social identity and sociolinguistic description. *Journal of Asian Pacific Communication*, 1, 147-172.

Bongaerts, Theo (1999) Ultimate attainment in L2 pronunciation: The case of very advanced late learners. In David Birdsong (ed.), *Second language acquisition and the critical period hypothesis*, 133-159. Mahwah, NJ: Lawrence Erlbaum.

Bosch, Peter, Graham Katz & Carla Umbach (2007). The Non-subject Bias of German Demonstrative Pronouns. In Monika Schwarz-Friesel, Manfred Consten & Mareile Knees (eds.), *Anaphors in Text: Cognitive, formal and applied approaches to anaphoric reference*, 145-164. Amsterdam: John Benjamins.

Broselow, Ellen (1987) Non-obvious transfer: On predicting epenthesis errors. In Georgette Ioup & Steven H. Weinberger (eds.), *Interlanguage phonology: The acquisition of a second language sound system*, 292-304. Rowley, MA: Newbury House.

Broselow, Ellen (2015) The typology of position-quality interactions in loanword vowel insertion. In Yuchau E. Hsiao & Lian-Hee Wee (eds.), *Capturing Phonological Shades Within and Across Languages*, 292-319. Newcastle upon Tyne: Cambridge Scholars Publishing.

Broselow, Ellen, Su-I. Chen & Chilin Wang. 1998. The emergence of the unmarked in second language phonology. *Studies in Second Language Acquisition*, 20, 261-280.

Broselow, Ellen & Zheng Xu (2004) Differential difficulty in the acquisition of second language phonology. *International Journal of English Studies*, 4, 135-163.

Bruthiaux, Paul (2003) Squaring the circles: Issues in modeling English worldwide. *International Journal of Applied Linguistics*, 13(2), 159-178.

Camacho, Jose (1999) From SOV to SVO: The grammar of interlanguage word order. *Second Language Research*, 15, 115-132.

Carlisle, Robert S. (1997) The modification of onsets in a markedness relationship: Testing the interlanguage structural conformity hypothesis. *Language Learning*, 47, 327-361.

Carlisle, Robert S. (1998) The acquisition of onsets in a markedness relationship: A longitudinal study. *Studies in Second language Acquisition,* 20, 245-260.

Cavallaro, Francesco & Bee-Chin Ng (2009) Between status and solidarity in Singapore. *World Englishes*, 28, 143-159.

Cazden, Courtney, Herlinda Cancino, Ellen Rosansky & John Schumann (1975) *Second language acquisition sequences in children adolescents and adults*. Washington, DC: U.S. Department of Health, Education and Welfare, National Institute of Edcation Office of Research Grants.

Chan, Alice Y. W. (2007) The acquisition of English word-final consonants by Cantonese ESL learners in Hong Kong. *Canadian Journal of Linguistics*, 52, 231-254.

Chan, Alice Y. W. (2010) An investigation into Cantonese ESL learners' acquisition of English initial consonant clusters. *Linguistics*, 48(1), 99-141.

Chiu, Crystal Y. L. (2008) *Consonant cluster simplification in Hong Kong English*. BA thesis, Hong Kong Baptist University.

Chomsky, Noam (1965) *Aspects of the theory of syntax*. Cambridge, MA: MIT Press.

Chomsky, Noam (1981). *Lectures on government and binding*. Dordrecht: Foris Publications.

Chomsky, Noam (1986) *Knowledge of language: Its nature, origin, and use*. New York: Praeger.

Chomsky, Noam & Morris Halle (1968) *The sound pattern of English*. New York: Haper & Row.

Clement, Richard (1980) Ethnicity, contact and communicative competence in a second language. In Howard Giles, W. Peter Robinson & Philip M. Smith (eds.), *Language: Social Psychological Perspectives*, 147-154. Oxford: Pergamon.

Clements, George N. (1990) The Role of the Sonority Cycle in Core Syllabification. In John Kingston & Mary Beckman (eds.), *Papers in Laboratory Phonology I*, 283-333. Cambridge: Cambridge University Press.

Conradie, Simone (2006) Investigating the acquisition of the Split-IP parameter and the V2 parameter in second language Afrikaans. *Second Language Research*, 22, 64-94.

Crystal, David (2003) *English as a global language*. Cambridge: Cambridge University Press.

Davidson, Lisa, Peter Jusczyk & Paul Smolensky (2004) The initial and final states: Theoretical implications and experimental explorations of Richness of the Base. In Rene Kager, Joe Pater & Wim Zonneveld (eds.), *Constraints in* *phonological acquisition*, 321-368. Cambridge: Cambridge University Press.

DeKeyser, Robert (2000) The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition*, 22, 493-533.

Dekydtspotter, Laurent, Rex A. Sprouse & Bruce Anderson (1997) The interpretive interface in L2 acquisition: The process-result distinction in English-French interlanguage grammars. *Language Acquisition*, 6, 297-332.

Demuth, Katherine (1995) Markedness and the development of prosodic structure. In Jill N. Beckman (ed.), *Proceedings of the North East Linguistic Society*, 25, 13–25. Amherst, MA: GLSA, University of Massachusetts.

de Lacy, Paul (2006) *Markedness: Reduction and preservation in phonology*. Cambridge: Cambridge University Press.

Deterding, David (2006) The pronunciation of English by speakers from China. *English World-Wide*, 27, 175-198.

Deterding, David, Jennie Wong, & Andy Kirkpatrick (2008). The pronunciation of Hong Kong English. *English World-wide*, 29, 148–175.

Dewaele, Jean-Marc (2005) Sociudemographic, psychological and politico-cultural correlates in Flemish students' attitudes toward French and English. Journal *of Multilingualism and Multicultural Development*, 26, 118-137.

Dussias, Paola E. & Nuria Sagara (2007) The effect of exposure on syntactic parsing in Spanish-English L2 speakers. *Bilingualism, Language and Cognition*, 10, 101-116.

Eckman, Fred R. (1977) Markedness and the contrastive analysis hypothesis. *Language Learning*, 27, 315-330.

Eckman, Fred R. (1984) Universals, typologies, and interlanguage. In William E. Rutherford (ed.), *Language universals and second language acquisition*, 79-105. Amsterdam: John Benjamins.

Eckman, Fred R. (1991) The structural conformity hypothesis and the acquisition of consonant clusters in the interlanguage of ESL learners. *Studies in Second Language Acquisition*, 13, 23-41.

Eckman, Fred R. (2008) Typological markedness and second language phonology. In Jette G. Hansen Edwards & Mary L. Zampini (eds.), *Phonology and second language acquisition*, 95-115. Amsterdam: John Benjamins.

Eckman, Fred R., Lawrence Bell & Diane Nelson (1988) On the generalization of relative clause instruction in the acquisition of English as a second language. *Applied Linguistics*, 9, 1-20.

El-Dash, Linda G. & Joanne Busnardo (2001) Brazilian Attitudes toward English: dimensions of status and solidarity. *International Journal of Applied Linguistics*, 11, 57-74.

Ellis, Rod (2008) *The study of second language acquisition*. Oxford: Oxford University Press.

Epstein, Samuel, Suzanne Flynn & Gita Martohardjono (1996) Second language acquisition: Theoretical and experimental issues in contemporary research. *Brain and Behavioral Sciences*, 19, 677-758.

Epstein, Samuel, Suzanne Flynn & Gita Martohardjono (1998) The strong continuity hypothesis: Some evidence concerning functional categories in adult L2 acquisition. In Suzanne Flynn, Gita Martohardjono & Wayne O'Neil (eds.), The generative study of second language acquisition, 61-77. Mihwah: NJ: Lawrence Erlbaum.

Fathman, Ann (1978) ESL and EFL learning: Similar or dissimilar? In C. Blatchford & J. Schachter (eds.), *On TESOL '78: EFL Policies, programs, Practices*, 213-223. Washington D.C.: TESOL.

Fikkert, Paula & Helen de Hoop (2009) Language acquisition in optimality theory. *Linguistics*, 311-357.

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

Flynn, Suzanne (1987) *A parameter-setting model of L2 acquisition*. Dordrecht: Reidel.

Flynn, Suzanne (1996) A parameter-setting approach to second language acquisition. In William C. Ritchie & Tej K. Bhatia (eds.), *Handbook of language acquisition*, 121-158. San Diego, CA: Academic Press.

Frisch, Stefan A., Janet B. Pierrehumbert & Michael B. Broe (2004) Similarity avoidance and the OCP. *Natural Language & Linguistic Theory*, 22, 179-228.

Gardner, Robert C. (1985) *Social psychology and second language learning: The role of attitudes and motivation*. London: Edward Arnold.

Gardner, Robert C. & Wallace E. Lambert (1972) *Attitudes and motivation in second language learning*. Rowley, MA: Newbury House. Gardner, Robert C. (1979) Social psychological aspect of second language acquisition. In Howard Giles & Robert StClair (eds.), *Language and social psychology*, 193-220. Oxford: Basil Blackwell.

Gass, Susan (1987) The resolution of conflicts among competing systems: A bidirectional perspective. *Applied Psycholinguistics*, 8, 329-350.

Gass, Susan M. (1997) *Input, interaction and the second language learner*. Mahwah, NJ: Lawrence Erlbaum.

Gass, Susan M. & Usha Lakshmanan (1991) Accounting for interlanguage subject pronouns. Se*cond Language Research*, 7, 181-203.

Giles, Howard & Jane L. Byrne (1982) An intergroup approach to second language acquisition. *Journal of Multilingual and Multicultural Development*, 1, 17-40.

Gnanadesikan, Amalia (2004) Markedness and faithfulness constraints in child phonology. In Rene Kager, Joe Pater & Wim Zonneveld (eds.), *Constraints in phonological acquisition*, 73-108. Cambridge: Cambridge University Press.

Goldwater, Sharon & Mark Johnson (2003) Learning OT constraint rankings using a maximum entropy model. In Jennifer Spenader, Anders Eriksson & Osten Dahl (eds.), *Proceedings of the Stockholm Workshop on Variation within Optimality Theory*, 111–120.

Gottfried, Terry L., & Patrice S. Beddor (1988) Perception of temporal and spectral information in French vowels. *Language and Speech*, 31, 57-75.

Greenberg, Joseph H. (1978) Some generalizations concerning initial and final consonant clusters. In Joseph H. Greenberg, Charles A. Ferguson & Edith A. Moravcsik (eds.), *Universals of human language*, vol. 2, 243-279. Stanford, CA: Stanford University Press.

Griffen, Toby D. (1980) A nonsegmental approach to the teaching of pronunciation. *Revue de Phonetique Appliquee*, 54, 81-94.

Habib, Rania (2008) *New model for analyzing sociolinguistic variation: The interaction of social and linguistic constraints*. PhD dissertation, University of Florida.

Hakuta, Kenji, Ellen Bialystok & Edward Wiley (2003) Critical evidence: A test of the critical-period hypothesis for second-language acquisition. *Psychological Science*, 14, 31-38.

Hall, Bradford J. & William B. Gudykunst (1987) The intergroup theory of second language ability. *Journal of Language and Social Psychology*, 5, 291-301.

Hanamoto, Hiroki (2013) Intelligibility and acceptability of collocations from an EIL perspective – A study based on a corpus of speech by Japanese learners of English. In *Proceedings of the Learner Corpus Studies in Asia and the World*, 1, 161-177.

Hancin-Bhatt, Barbara (2008) Second language phonology in optimality theory. In Jette G. Hansen Edwards & Mary L. Zampini (eds.), *Phonology and second language acquisition*, 117-146. Amsterdam: John Benjamins.

Hancin-Bhatt, Barbara & Rakesh M. Bhatt (1997) Optimal L2 syllables: Interaction of transfer and developmental effects. *Studies in Second Language Acquisition*, 19, 331-378.

Hayes, Bruce & Colin Wilson (2008) A maximum entropy model of phonotactics and phonotactic learning. *Linguistic Inquiry*, 39, 379-440.

Hudson, Richard A. (2000) *Sociolinguistics*. Beijing: Foreign Language Teaching and Research Press/Cambridge: Cambridge University Press.

Hung, Tony T. N. (2000) Towards a Hong Kong English phonology. *World Englishes*, 19, 337-356.

Ito, Junko (1986) *Syllable theory in prosodic phonology*. PhD dissertation, University of Massachusetts, Amherst.

Ito, Junko & R. Armin Mester (1998) *Markedness and word structure: OCP effects in Japanese*. Ms., University of California, Santa Cruz. [ROA-255, http://ruccs.rutgers.edu/roa.html]

Ioup, Georgtte, Elizabeth Boustagui, Manal El Tigi & Martha Moselle (1994) Reexamining the critical period hypothesis: a case study of successful adult SLA in a naturalist environment. *Studies in Second Language Acquisition*, 16, 73-98.

Iverson, Paul, & Patricia K. Kuhl (1995) Mapping the perceptual magnet effect for speech using signal detection theory and multidimensional scaling. *Journal of the Acoustical Society of America*, 97, 553-562.

Jager, Gerhard (2004) *Maximum entropy models and stochastic Optimality Theory*. [Rutgers Optimality Archive, 625]. Retrieved on July 3, 2014.

Jenkins, Jennifer (2015) *Global Englishes*. Oxford: Routledge.

Johnson Jacqueline & Elissa Newport (1989) Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a Second Language. *Cognitive Psychology*, 21, 60-99.

Kachru, Braj B. (1976) Models of English for the Third World: White man's linguistic burden or language pragmatics? *TESOL Quarterly*, 10, 221-239.

Kachru, Braj B. (1985) Standards, codification and sociolinguistic realism: The English language in the Outer Circle. In Randolph Quirk & H. G. Widdowson (eds.), *English in the World: Teaching and learning the language and literatures*, 11-30. Cambridge: Cambridge University Press.

Kachru, Braj B. (1991) Liberation linguistics and the Quirk concern. In Makhan L. Tickoo (ed.), *Languages & standards: Issues, attitudes, case studies*, 206-226. Singapore: SEAMEO Regional Language Center.

Kachru, Braj B. (1992) Teaching World Englishes. In Braj B. Kachru (ed.), *The other tongue: English across cultures*, 355-365. Urbana: University of Illinois Press.

Kager, Rene (1999) *Optimality theory*. Cambridge: Cambridge University Press.

Kanno, Kazue (1997) The acquisition of null and overt pronominals in Japanese by English speakers. *Second Language Research*, 13, 265-287.

Kelly, Caroline, Itesh Sachdev, Petra Kottsieper & Maysa Ingram (1993) The role of social identity in second-language proficiency and use: Testing the intergroup model. *Journal of Language and Social Psychology*, 12, 288-301.

Keenan, Edward & Bernard Comrie (1977) Noun phrase accessibility and universal grammar. *Linguistic Inquiry*, 8, 63-99.

Kenstowicz, Michael (1994) *Phonology in generative grammar*. Cambridge, MA: Blackwell.

Kioko, Angelina N. & Margaret J. Muthwii (2001) The demands of a changing society: English in education in Kenya Today. *Language, Culture and Curriculum*, 14, 201-213.

Kirkpatrick, A. (2007). *World Englishes: Implications for international communication and English language teaching*. Cambridge: Cambridge University Press.

Ko, Heejeong (2005) *Interlanguage grammar in second language acquisition*. Ms. Massachusetts Institute of Technology. Retrieved on April 11, 2014.

Krashen, Stephen (1982) *Principles and practice in second language acquisition*. Oxford: Pergamon.

Lado, Robert (1957) *Linguistics across cultures*. Ann Arbor: University of Michigan Press.Lenneberg, Eric H. (1967) *Biological foundations of language*. New York: Wiley.

Lambert, Wallace E., Richard C. Hodgson, Robert C. Gardner & Samuel Fillenbaum (1960) Evaluational reactions to spoken languages. *Journal of Abnormal and Social Psychology*, 60, 44–51.

Leben, William (1973) S*uprasegmentul Phonology*. PhD dissertation, Massachusetts Institute of Technology.

Legendre, Geraldine (2006) Early child grammars: Qualitative and quantitative analysis of morphosyntactic production. *Cognitive Science*, 30, 803–835.

Lightbown, Patsy M. & Nina Spada (2006) *How languages are learned*. Oxford: Oxford University Press.

Lim, Lisa (2007) Mergers and acquisitions: On the ages and origins of Singapore English particles. *World Englishes*, 26(4), 446-473.

Lin, Yuh-Huey (2001) A constraint-based approach to Chinese speakers' acquisition of English consonant clusters. *Concentric: Studies in English Literature and Linguistics*, 27, 1-33.

Lombardi, Linda (1999) Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language and Linguistic Theory*, 17, 267–302.

Lombardi, Linda (2003) Second language data and constraints on Manner: Explaining substitution for English interdentals. *Second Language Research*, 19, 225-250.

Lo, Sun-Keung (2007) *The markedness differential hypothesis and the acquisition of English final consonants by Cantonese ESL learners in Hong Kong*. MPhil thesis, City University of Hong Kong.

Lowenberg, Peter H. (1992) Testing English as a world language: Issues in assessing non-native proficiency. In Braj B. Kachru (ed.), *The other tongue: English across cultures*, 108-121. Urbana: University of Illinois Press.

Macauley, Ronald (1988) "RP R.I.P." *Applied Linguistics*, 9, 115-124.

Major, Roy (2008) Transfer in second language phonology. In Jette G. Hansen Edwards & Mary L. Zampini (eds.), *Phonology and second language acquisition*, 63-94. Amsterdam: John Benjamins.

McCarthy, John J. (1986) OCP Effects: Antigemination and Gemination. *Linguistic Inquiry*, 17, 207-263.

McKenzie, Robert M. (2010) *The social psychology of English as a global language: Attitudes, awareness and identity in the Japanese context*. Dordrecht: Springer.

Menezes, Vera (2013) Second language acquisition: Reconciling theories. *Open Journal of Applied Sciences*, 3, 404-412.

Mohanan, Karuvannur P. (1992). *Describing the phonology of non-native varieties of a Language*. *World Englishes*, 11, 111-128.

Mohanan. Karuvannur P. (2003) *Uniting Chomskian linguistics and sociolinguistics*. Talk given at the Department of Linguistics, Stanford University. Retrieved on May 24, 2012.

Morgan, Carol (1993) Attitude change and foreign language culture learning. *Language Teaching*, 26, 63-75.

Munro, Murray J. (2008) Foreign accent and speech intelligibility. In In Jette G. Hansen Edwards & Mary L. Zampini (eds.), *Phonology and second language acquisition*, 193-218. Amsterdam: John Benjamins.

Munro, Murray J. & Tracey M. Derwing (1995) Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning*, 45, 73-97.

Norton, Bonny (2000) *Identity and language learning: Gender, ethnicity and educational change*. Essex: Pearson Education Limited.

Odden, David (2005) *Introducing phonology*. Cambridge: Cambridge University Press.

Ong, Yin Hsiar (2007) *Phonological elision in Malaysian Cantonese casual speech*. MA thesis, National University of Singapore.

Otsu, Yukio, & Kazuhiro Naoi (1986) Structure dependence in L2 acquisition. Paper presented at the meeting of the Japan Association of College English Teachers (JACET), Keio University, Tokyo.

Oyama, Susan (1973) *A sensitive period for the acquisition of a second language*. PhD dissertation, Harvard University.

Pater, Joseph (1996) *Consequences of constraint ranking*. PhD dissertation, McGill University.

Pater, Joe & Andries Coetzee (2005) Lexically specific constraints: Gradience, learnability, and perception. In *Proceedings of the 3rd Seoul International Conference on Phonology*, 85-119. Seoul: The Phonology-Morphology Circle of Korea.

Patkowski, Mark (1980) The sensitive period for the acquisition of syntax in a second language. *Language Learning*, 30, 449-472.

Penfield, Wilder & Lamar Robert (1959) *Speech and brain mechanism*. New York: Athenaeum.

Peng, Long & Jean Ann (2004) Obstruent voicing and devoicing in the English of Cantonese speakers from Hong Kong. *World Englishes*, 23, 535-564.

Perez-Leroux, Ana T. & William Glass (1999) Null anaphora in Spanish second language acquisition: Probabilistic versus generative approaches. *Second Language Research*, 15, 220-249.

Peters, Nathaniel (2006) *C'est pas blesipo: Variations of Verlan*. Senior linguistics thesis, Swarthmore College.

Piggot, Glyne L. (2003) Theoretical implications of segment neutrality in nasal harmony. *Phonology*, 20, 375-424.

Pilus, Zahariah (2013) Exploring ESL learners' attitudes towards English accents. *World Applied Sciences Journal*, 21, 143-152.

Platzack, Christer (1996) The initial hypothesis of syntax: A minimalist perspective on language acquisition and attrition. In Harald Clahsen (ed.) *Generative perspectives on language acquisition: Empirical findings, theoretical considerations, crosslinguistic comparisons*, 369-414. Amsterdam: John Benjamins.

Prince, Alan & Paul Smolensky (1993/2004) *Optimality theory: Constraint interaction in generative grammar*. Malden, MA: Blackwell.

Prince, Alan & Bruce Tesar (2004) Learning phonotactic distributions. In Rene Kager, Joe Pater & Wim Zonneveld (eds.), *Constraints in phonological acquisition*, 245-291. Cambridge: Cambridge University Press.

Qin, Chuan (2010) Investigating L1 transfer in L2 speech perception: Evidence from Vietnamese speakers' perception of English vowel contrasts. *HKBU Papers in Applied Language Studies*, 14, 73-107.

Qin, Chuan (2014) *On the initial state in OT grammar*. Ms. Hong Kong Baptist University. [in Chinese]

Rice, Keren (2007) Markedness in phonology. In Paul de Lacy (ed.), *The*

Cambridge handbook of phonology, 79-97. Cambridge: Cambridge University Press.

Richards, Jack C. & Richard Schmidt (2002) *Longman Dictionary of Language Teaching and Applied Linguistics*. London: Longman.

Rivers, M. Wilga (1968) *Teaching foreign language skills*. Chicago: Chicago University Press.

Roach, Peter (2000) *English phonetics and phonology: A practical course*. Cambridge: Cambridge University Press.

Roca, Iggy & Wyn Johnson (1999) *A course in phonology*. Malden, MA: Blackwell.

Schachter, J. (1988) Second language acquisition and its relationship to Universal Grammar. *Applied Linguistics*, 9, 219-235.

Schumann, John H. (1978) Social and psychological factors in second language acquisition. In Jack Richards (ed.), *Understanding second and foreign language learning: Issues and approaches*, 163-178. Rowley, MA: Newbury House.

Schumann, John H. (1986) Research on the acculturation model for second language acquisition. *Journal of Multilingual and Multicultural Development*, 7, 379-392.

Schwartz, Bonnie D. & Rex A. Sprouse (1994) Word order and nominative case in nonnative language acquisition: A longitudinal study of (L1 Turkish) German interlanguage. In Teun Hoekstra & Bonnie D. Schwartz (eds.), *Language acquisition studies in generative grammar*, 317-368. Amsterdam: John Benjamins.

Schwartz, Bonnie D. & Rex A. Sprouse (1996) L2 cognitive states and the full transfer/full access model. *Second Language Research*, 12, 40-72.

Selinker, Larry (1972) Interlanguage. *IRAL*, 10, 209-231.

Selkirk, Elisabeth O. (1984). On the major class features and syllable theory. In M. Aronoff & R. T. Oehfle (eds)., *Language Sound Structures*, 107-136. Cambridge, MA: MIT Press

Setter, Jane, Cathy S.P. Wong & Brian H.S. Chan (2010) *Hong Kong English*. Edinburgh: Edinburgh University Press.

Sewell, Andrew (2012) The Hong Kong English accent: variation and acceptability. *Hong Kong Journal of Applied Linguistics*, 13, 1-21.

Siegel, Jeff (2003) Social context. In Catherine J. Doughty & Michael H. Long (eds.), *The handbook of second language acquisition*, 178-223. Malden, MA: Blackwell.

Silverman, Daniel (1992) Multiple Scansions in Loanword Phonology: Evidence from Cantonese. *Phonology*, 9, 289-328.

Skinner, Burrhus F. (1957) *Verbal behavior*. New York: Appleton-Century-Crofts.

Smith, Larry E. (1992) Spread of English and issues of intelligibility. In Braj B. Kachru (ed.), *The other tongue: English across cultures*, 75-90. Urbana: University of Illinois Press.

Smith, Larry E. & Khalilullah Rafiqzad (1979) English for cross-cultural communication: The question of intelligibility. *TESOL Quarterly*, 13, 371-380.

Smolensky, Paul (1996a) On the comprehension/production dilemma in child language. *Linguistic Inquiry*, 27, 720-731.

Smolensky, Paul (1996b) *The initial state and 'Richness of the Base' in optimality theory*. Technical report JHU-CogSci-96-4, Department of Cognitive Science, Johns Hopkins University. [Rutgers Optimality Archive, 154]. Retrieved on June 5, 2012.

Sridhar, Kamal K. & S. N. Sridhar (1992) Bridging the paradigm gap: Second-language acquisition theory and indigenized varieties of English. In Braj B. Kachru (ed.), *The other tongue: English across cultures*, 91-107. Urbana: University of Illinois Press.

Tan, Peter K. W. & Daniel K. H. Tan (2008) Attitudes towards non-standard English in Singapore. *World Englishes*, 27, 465-479.

Tarone, Elaine (1994) Interlanguage. In Ronald Asher (ed.), *The encyclopedia of language and linguistics, vol. 4*, 1715-1719. Oxford: Pergamon Press.

Tesar, Bruce & Paul Smolensky (1998) Learnability in optimality theory. *Linguistic inquiry*, 29, 229-268.

Tesar, Bruce & Paul Smolensky (2000) *Learnability in optimality theory*. Cambridge, MA: MIT Press.

Vainikka, Anne & Martha Young-Scholten (1994) Direct access to X'-Theory: Evidence from Korean and Turkish adult learners of German. In Teun Hoekstra & Bonnie Schwartz (eds.), *Language acquisition studies in generative grammar*, 265-316. Amsterdam: John Benjamins.

Van Wijngaarden, Sander J. (2001) Intelligibility of native and non-native Dutch speech. *Speech Communication*, 35, 103-113.

Van Wuitswinkel, K. (1994) *Critical period effects on the acquisition of grammatical competence in a second*. BA thesis, Katholieke Universiteit, Nijmengen.

Vaux, Bert & Bridget Samuels (2005) Laryngeal markedness and aspiration. *Phonology*, 22, 395-436.

Velleman, Shelley L. & Marilyn M. Vihman (2002) *The optimal initial state*. [Rutgers Optimality Archive, 552]. Retrieved on June 28, 2012.

Walter, Daniel R. (2011) *L1 English L2 German learners' grammaticality judgments and knowledge of demonstrative pronouns*. MA thesis, Michigan State University.

Wardhaugh, Ronald (1970) The contrastive analysis hypothesis. *TESOL Quarterly*, 4, 123-130.

Wee, Lian-Hee (2006) Syllabification Paradox - Hong Kong Transliteration of English Words. In *Proceedings of SICOL 2006*, 288-397.

Wee, Lian-Hee (2008) Phonological patterns in the Englishes of Singapore and Hong Kong. *World Englishes*, 27, 480-501.

Wee, Lian-Hee (2009) Exploring the dilemma of the split L-geminates in Hong Kong English. In Linda Uyechi & Lian-Hee Wee (eds.), *Reality exploration and discovery: Pattern interaction in language and life*, 89-104. Stanford, CA: CSLI Publications.

Weinberger, Steven H. (1987) The influence of linguistic context on syllable simplification. In Georgette Ioup & Steven H. Weinberger (eds.), *Interlanguage phonology: The acquisition of a second language sound system*, 401-417. Rowley, MA: Newbury House.

Wexler, Kenneth & Peter W. Culicover (1980) *Formal principles of language acquisition*. Cambridge, MA: MIT Press.

White, Lydia (1991) Adverb placement in second language acquisition: Some effects of positive and negative evidence in the classroom. *Second Language Research*, 7, 133-161.

White, Lydia (2003a) *Second Language acquisition and universal Grammar*. Cambridge: Cambridge University Press.

White, Lydia (2003b) On the nature of interlanguage representation: Universal grammar in the second language. In Catherine J. Doughty & Michael H. Long (eds.), *The handbook of second language acquisition*, 19-42. Malden, MA: Blackwell.

White, Lydia & Fred Genesee (1996) How native is near-native? The issue of ultimate attainment in adult second language acquisition. *Second Language Research*, 11, 233-265.

Yam, Josephine P.S. (2005) *The acquisition of English consonant clusters by Hong Kong learners*. PhD dissertation, The Chinese University of Hong Kong.

Yip, Moria (1993) Cantonese Loanword Phonology and Optimality Theory. *Journal of East Asian Linguistics*, 2, 261-291.

Yip, Virginia & Stephen Mathews (1995) I-interlanguage and typology: the case of topic prominence. In L. Eubank et al (eds.), *The current state of Interlanguage*, 17-30. Amsterdam: John Benjamins.

Yuan, Boping (2001) The status of thematic verbs in the second language acquisition of Chinese: against inevitability of thematic-verb raising in second language acquisition. *Second Language Research*, 17, 248-272.

Yuan, Boping (2011) L1 Transfer at L2 syntax-discourse interfaces: Evidence from L2 Chinese "daodi…wh-" questions. In Julia Herschensohn & Darren Tanner (eds.), *Proceedings of the 11th Generative Approaches to Second Language Acquisition Conference (GASLA 2011)*, 152-161. Somerville, MA: Cascadilla Press.

Zhang, Qi (2010) *Attitudes beyond the Inner Circle: Investigating Hong Kong Students' Attitudes towards English Accents*. PhD dissertation, Newcastle University.

Appendix 1
Measurement of the Distance between Constraint Rankings

Inspired by the *r-measure* proposed by Prince & Tesar (2004), this dissertation measures the distance between two constraint rankings through the difference in dominance relationship. Suppose there are two rankings R_1 and R_2, shown below.

(1) a. R_1: $A^0, B^0 >> C^2, D^2$

b. R_2: $C^0 >> A^1 >> B^2 >> D^3$

A, *B*, *C*, and *D* denote different constraints. In R_1, *A* and *B* are dominated by no constraint, indicated by the superscript number “0”. *C* is dominated by two constraints (i.e. *A* and *B*), denoted by the superscript “2”. The same is for *D*. Such number of constraints that dominate a given constraint is called the dominated value of a constraint. In R_2, *B* is dominated by *C* and *A*. Its dominated value is thus 2. The value of *D* is 3 since there are three constraints (*C*, *A*, and *B*) above it.

To measure the ranking distance between R_1 and R_2, one only needs to calculate the difference in dominated values between the constraints in each ranking. For *A*, the value difference is 1 (1-0=1); for *B*, the difference is 2 (2-0=2); for *C*, the difference is 2 (2-0=2); for D, it is 1 (3-2=1). When the differences of all constraints add up, one gets the ranking distance between R_1 and R_2. This distance is 6 (1+2+2+1=6). Greater similarity in the position of individual constraints certainly will lead to smaller ranking distance.

Appendix 2
Word List for the Production Test

1. afraid
2. age
3. Alps
4. amuse
5. anguish
6. anklet
7. ant
8. approve
9. ask
10. asked
11. asks
12. bangs
13. begged
14. begs
15. blast
16. bled
17. bloom
18. blunt
19. blur
20. brief
21. Britain
22. bronze
23. build
24. bulb
25. bulbs
26. cashback
27. clarify
28. Clark
29. clear
30. cliff
31. close
32. closure
33. clothing
34. clubbed
35. Constantine
36. corpse
37. crawl
38. crisp
39. crow
40. crown
41. cry
42. cube
43. digest
44. disband
45. disclaim
46. discuss
47. dumped
48. east
49. eats
50. Ed
51. edge
52. elf
53. else
54. elves
55. encourage
56. encouraging
57. English
58. ex-con
59. excuse
60. exhale
61. explode
62. fabric
63. fact
64. famed
65. fed
66. film
67. fish
68. flap
69. flirt
70. flu
71. fly
72. foolish
73. frank
74. Franks
75. free
76. freshness
77. friend
78. fringe
79. games
80. gasped
81. gasps
82. gave
83. glue
84. grab
85. grant
86. grape
87. help
88. helped
89. hobnob
90. implore

91. improve
92. inch
93. increasing
94. indefinite
95. independent
96. inflict
97. infuse
98. ink
99. inked
100. inks
101. instinct
102. instrument
103. i-Tunes
104. jasmine
105. jumps
106. kept
107. lapse
108. lapsed
109. larks
110. lend
111. lift
112. lisp
113. lived
114. lives
115. lock
116. log
117. lump
118. matched
119. melt
120. milk
121. misquote
122. ounce
123. owns
124. ox
125. participate
126. peacemaking
127. play
128. pray
129. presidency
130. puffs
131. raised
132. range
133. recommend
134. recruiter
135. refrigerator
136. relationship
137. representative
138. rushed
139. scratch
140. scree
141. segment
142. senseless
143. sequence
144. shameless
145. shelve
146. shelved
147. skate
148. skating
149. slope
150. small
151. smooth
152. snatch
153. spa
154. spare
155. sphere
156. spiritual
157. splendid
158. split
159. spoil
160. spray
161. spring
162. springs
163. squeeze
164. stain
165. star
166. string
167. stupid
168. suppose
169. swim
170. text
171. thankful
172. trenched
173. tweet
174. underpaid
175. understand
176. urge
177. Welsh
178. whereabout
179. wolf
180. woodland

Appendix 3

Question Sheet for the Attitudinal Test[1]

Note: You will hear several pronunciations for certain English words. Some of them are different while some are the same. When hearing a pronunciation, please rate whether you like it in a five-point scale. There is *no right or wrong*. You can give full mark (5 Points) to more than one pronunciation (you may even give full mark to all pronunciations if they are all acceptable to you).[2]

(Please circle from 1 to 5 where 1 is "Strongly disagree" and 5 is "Strongly agree")

1. Spring

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

2. Hence

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

3. Kept

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

4. Melt

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

---

[1] The tested words in Appendix 4 and 5 are randomized in the question sheet. This question sheet also includes several words with CCC syllable margins. These words however are not under the scope of the study because the dissertation focuses on CC syllable margins.

[2] The subjects were allowed to rate different pronunciation stimuli equally because language variation can often be found within a speech community. That is, the same underlying form may have multiple actual phonetic realizations. For example, in Makonde which is spoken in Mozambique, the phoneme /ʃ/ can be pronounced either as [s] or [ʃ] (Odden 2005:60). It is possible that these variants are evaluated equally by its speakers.

③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

5. Eats
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

6. Camp
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

7. Clear
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

8. Rent
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

9. East
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

10. Milk
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑥ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

11. Stay
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

12. AIDS
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

13. Help
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

14. Lend
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

15. Pray
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

16. Fact
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

17. Bronze

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

18. Lift

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

19. Bulb

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

20. Else

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

21. Frank

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑥ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑦ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

22. Ants

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

23. Range
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

24. Ox
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

25. Lisp
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

26. Text
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

27. Lived
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

28. Cry
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

29. Ask

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

30. Inch

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

31. Lifts

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

32. Clubbed

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

33. Lapse

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

34. Split

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

35. Build

I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

36. Play
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

37. Puffs
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

38. Begged
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

39. Self
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

40. Snow
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

41. Film
I like the way it is pronounced.
① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

42. Welsh

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

43. Facts

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

44. Bands

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

45. Shelve

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

46. Skate

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

47. Fly

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

48. Boasts

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

49. Alps

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

50. Opts

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

51. Sleep

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

52. Milked

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

53. Scratch

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

54. Hubs

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

55. Selves

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

56. Smoke

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

57. Milks

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
⑤ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

58. Speak

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
④ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

59. Whelm

I like the way it is pronounced.

① Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
② Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree
③ Strongly disagree ---- 1 ---- 2 ---- 3 ---- 4 ---- 5 ---- Strongly agree

Personal Information

Student ID _____________ **Age** ______________________

Gender ________________ **City of Origin** ____________

Languages known: English [ ] Cantonese [ ] Mandarin [ ] Others ________
(tick as appropriate)

Appendix 4

Stimuli Testing the Attitudes towards Consonant Clusters

A. The variant stimuli of the words testing onset clusters

1. Clear
    a. [k^{h}lɪə]
    b. [k^{h}ɪə]
    c. [k^{h}ə.ˈlɪə]
    d. [k^{h}.lɪə]

2. Cry
    a. [k^{h}ɹaɪ]
    b. [k^{h}aɪ]
    c. [k^{h}ə.ˈɹaɪ]
    d. [k^{h}.ɹaɪ]

3. Fly
    a. [flaɪ]
    b. [faɪ]
    c. [fu.ˈlaɪ]
    d. [f.laɪ]

4. Frank
    a. [fɹæŋk]
    b. [fæŋk]
    c. [fu.ˈɹæŋk]
    d. [f.ɹæŋk]

5. Pray
    a. [p^{h}ɹeɪ]
    b. [p^{h}eɪ]
    c. [p^{h}u.ˈɹeɪ]
    d. [p^{h}.ɹeɪ]

6. Scratch
    a. [skɹætʃ]
    b. [skætʃ]
    c. [skə.ˈɹætʃ]
    d. [s.kɹætʃ]

7. Skate
    a. [skeɪt]
    b. [seɪt]
    c. [sɪ.ˈkeɪt]
    d. [s.keɪt]

8. Smoke
   a. [smoʊk]
   b. [soʊk]
   c. [sɪ.ˈmoʊk]
   d. [s.moʊk]

9. Speak
   a. [spiːk]
   b. [siːk]
   c. [sɪ.ˈpiːk]
   d. [s.piːk]

10. Split
   a. [splɪt]
   b. [spɪt]
   c. [spu.ˈlit]
   d. [s.plɪt]

11. Spring
   a. [spɹɪŋ]
   b. [spɪŋ]
   c. [spʊ.ˈɹɪŋ]
   d. [s.pɹɪŋ]

12. Stay
   a. [steɪ]
   b. [seɪ]
   c. [sɪ.ˈteɪ]
   d. [s.teɪ]

B. The variant stimuli of the words testing coda clusters

13. AIDS
   a. [eɪdz]
   b. [eɪs]

14. Ask
   a. [ɑ:sk]
   b. [ɑ:s]
   c. [ˈɑ:s.kʰə]
   d. [ɑ:s.kʰ]

15. Bronze
   a. [bɹɒnz]
   b. [bɹɒn.s]

16. Camp

a. [k^{h}æmp]
b. [k^{h}æm]
c. [ˈk^{h}æm.p^{h}ə]
d. [k^{h}æm.p^h]

17. East
a. [iːst^h]
b. [iːs]
c. [ˈiːs.t^{h}ə]
d. [iːs.t^h]

18. Eats
a. [iːts]
b. [iːt]
c. [iːs]
d. [iː.t͡s̩]

19. Else
a. [els]
b. [el]
c. [ˈel.si]
d. [el.s]

20. Fact
a. [fæk^{h}t^h]
b. [fæk^h]
c. [fæt^h]
d. [ˈfæk.t^{h}ə]
e. [fæk.t^h]

21. Frank
a. [fɹæŋk^h]
b. [fɹæŋ]
c. [ˈfɹæŋ.k^{h}ə]
d. [fɹæŋ.k^h]

22. Help
a. [help]
b. [hel]
c. [ˈhel.p^{h}ʊ]
d. [hel.p^h]

23. Hence
a. [hens]
b. [hen]
c. [hen.sɪ]
d. [hen.s]

24. Inch
    a. [intʃ]
    b. [in]
    c. [ˈin.tʃi]
    d. [in.tʃ]

25. Kept
    a. [kept]
    b. [kep]
    c. [ˈkep.tʰə]
    d. [kep.tʰ]

26. Lapse
    a. [læps]
    b. [læs]
    c. [læp]
    d. [ˈlæ.pʰʊs]
    e. [læp.s]

27. Lift
    a. [lɪft]
    b. [lɪf]
    c. [ˈlif.tʰə]
    d. [lif.tʰ]

28. Lisp
    a. [lɪsp]
    b. [lɪs]
    c. [ˈlɪs.pʰʊ]
    d. [lɪps]
    e. [lɪs.pʰ]

29. Melt
    a. [melt]
    b. [mel]
    c. [ˈmel.tʰə]
    d. [mel.tʰ]

30. Milk
    a. [mɪlk]
    b. [mɪl]
    c. [mɪk]
    d. [ˈmɪl.kʰə]
    e. [mɪl.kʰ]

31. Puffs
    a. [pʰʌfs]
    b. [pʰʌf]

c. [ˈp^{h}ʌ.fʊs]
d. [p^{h}ʌf.s]

32. Range
a. [ɹeɪn.dʒ]
b. [ɹeɪndʒ]

33. Rent
a. [ɹent^{h}]
b. [ɹen]
c. [ˈɹen.t^{h}ə]
d. [ɹen.t̪^{h}]

34. Self
a. [self]
b. [sel]
c. [ˈsel.fʊ]
d. [sel.f]

35. Shelve
a. [ʃelv]
b. [ʃel]
c. [ʃel.f]

36. Welsh
a. [welʃ]
b. [wel]
c. [ˈwel.ʃɪ]
d. [wel.ʃ]

Appendix 5

Stimuli Testing the Attitudes towards Final Obstruent Devoicing

1. Begged
   a. [begd]
   b. [bek^{h}t^{h}]

2. Bronze
   a. [bɹɒnz]
   b. [bɹɒns]

3. Build
   a. [bɪld]
   b. [bɪlt^{h}]

4. Bulb
   a. [bʌlb]
   b. [bʌlp^{h}]

5. Clubbed
   a. [k^{h}lʌbd]
   b. [k^{h}lʌp^{h}t^{h}]

6. Hubs
   a. [hʌbz]
   b. [hʌp^{h}s]

7. Lend
   a. [lend]
   b. [lent^{h}]

8. Lived
   a. [lɪvd]
   b. [lɪft]

9. Range
   a. [ɹeɪndʒ]
   b. [ɹeɪntʃ]

10. Shelve
    a. [ʃelv]
    b. [ʃelf]

Appendix 6
Average Preference Ratings of the Stimuli in the Attitudinal Test
(the Hong Kong Study)

A. The average preference ratings of the stimuli testing consonant clusters

The table in (A6-1) shows the average preference ratings made by the 129 Hong Kong subjects towards the different variant stimuli testing consonant clusters (cf. Appendix 4). Based on the preference judgments made in a 5-point scale (cf. (4-16)), the maximum mean score is 5 and the minimum is 1, with a higher score indicating a higher degree of preference. Within each tested word, the mean scores of different variant stimuli are arranged from high to low. The rightmost column indicates whether the mean score of a certain variant is significantly different from the highest-rated one, following the Student-Newman-Keuls (SNK) test ($p < 0.05$). In this column, “Yes” indicates a variant significantly lower than the highest-rated one; “No” means that a variant is statistically similar to the highest-rated one and hence can also be regarded as highest preferred; the highest-rated variant is marked as “N/A”.

(A6-1) Average preference ratings of the stimuli testing consonant clusters

No.	Tested words	Variant stimuli	Means	Standard deviation	Whether significantly lower than the highest one ($p < 0.05$)
1.	*Clear*	[kʰlɪə]	4.33	0.75	N/A
		[kʰ.lɪə]	1.58	0.84	Yes
		[kʰɪə]	1.44	0.71	Yes
		[kʰə.ˈlɪə]	1.44	0.69	Yes
2.	*Cry*	[kʰɹaɪ]	3.80	1.04	N/A
		[kʰ.ɹaɪ]	3.42	1.12	Yes
		[kʰə.ˈɹaɪ]	2.70	1.17	Yes
		[kʰaɪ]	1.19	0.45	Yes
3.	*Fly*	[flaɪ]	4.06	0.87	N/A
		[fu.ˈlaɪ]	3.11	1.21	Yes
		[f.laɪ]	2.96	1.19	Yes
		[faɪ]	1.48	0.71	Yes
4.	*Frank*	[fɹæŋk]	2.90	1.25	N/A
		[fu.ˈɹæŋk]	2.81	1.11	No
		[f.ɹæŋk]	2.06	0.99	Yes
		[fæŋk]	1.71	1.01	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
5.	*Pray*	[pʰ.ɹeɪ]	2.34	1.16	N/A
		[pʰu.ˈɹeɪ]	1.91	0.96	Yes
		[pʰɹeɪ]	1.85	0.94	Yes
		[pʰeɪ]	1.33	0.63	Yes
6.	*Scratch*	[skɹætʃ]	4.34	0.73	N/A
		[s.kɹætʃ]	3.80	0.99	Yes
		[skə.ˈɹætʃ]	2.52	1.02	Yes
		[skætʃ]	1.57	0.82	Yes
7.	*Skate*	[skeɪt]	3.01	1.14	N/A
		[s.keɪt]	2.22	1.02	Yes
		[seɪt]	1.23	0.46	Yes
		[sɪ.ˈkeɪt]	1.11	0.36	Yes
8.	*Smoke*	[smoʊk]	4.14	0.92	N/A
		[s.moʊk]	3.12	0.99	Yes
		[soʊk]	1.29	0.52	Yes
		[sɪ.ˈmoʊk]	1.24	0.56	Yes
9.	*Speak*	[s.piːk]	2.88	1.06	N/A
		[spiːk]	2.31	1.10	Yes
		[siːk]	1.20	0.48	Yes
		[sɪ.ˈpiːk]	1.20	0.54	Yes
10.	*Split*	[s.plɪt]	3.57	1.12	N/A
		[splɪt]	3.47	1.21	No
		[spu.ˈlit]	2.88	1.18	Yes
		[spɪt]	1.67	0.99	Yes
11.	*Spring*	[spɹɪŋ]	3.59	0.86	N/A
		[s.pɹɪŋ]	3.42	0.99	No
		[spʊ.ˈɹɪŋ]	3.10	0.90	Yes
		[spɪŋ]	1.34	0.61	Yes
12.	*Stay*	[s.teɪ]	3.13	1.21	N/A
		[steɪ]	2.35	1.17	Yes
		[sɪ.ˈteɪ]	1.14	0.50	Yes
		[seɪ]	1.12	0.35	Yes
13.	*AIDS*	[eɪs]	3.35	1.12	N/A
		[eɪdz]	1.91	0.90	Yes
14.	*Ask*	[ɑːskʰ]	4.08	0.87	N/A
		[ɑːs.kʰ]	3.78	0.94	Yes
		[ɑːs]	2.44	1.00	Yes
		[ˈɑːs.kʰə]	1.98	0.91	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
15.	*Bronze*	[bɹɒn.s]	3.93	0.90	N/A
		[bɹɒnz]	3.80	0.95	No
16.	*Camp*	[k^{h}æmp]	4.09	0.98	N/A
		[k^{h}æm.p^{h}]	3.77	1.07	Yes
		[k^{h}æm]	2.80	1.18	Yes
		[ˈk^{h}æm.p^{h}ə]	2.12	0.91	Yes
17.	*East*	[iːst^{h}]	3.73	1.01	N/A
		[iːs.t^{h}]	3.18	1.07	Yes
		[iːs]	2.14	0.95	Yes
		[ˈiːs.t^{h}ə]	1.40	0.58	Yes
18.	*Eats*	[i:ts]	3.61	0.99	N/A
		[i:s]	3.11	1.10	Yes
		[i:t]	2.02	0.84	Yes
19.	*Else*	[els]	4.02	0.91	N/A
		[el.s]	3.78	0.94	Yes
		[el]	3.09	0.63	Yes
		[ˈel.si]	1.24	0.56	Yes
20.	*Fact*	[fæk^{h}t^{h}]	4.09	0.94	N/A
		[fæt^{h}]	3.48	1.33	Yes
		[fæk.t^{h}]	2.97	1.01	Yes
		[fæk^{h}]	2.25	0.94	Yes
		[ˈfæk.t^{h}ə]	1.55	0.68	Yes
21.	*Frank*	[fɹæŋ.k^{h}]	2.99	1.24	N/A
		[fɹæŋk^{h}]	2.91	1.25	No
		[ˈfɹæŋ.k^{h}ə]	2.84	1.05	No
		[fɹæŋ]	2.02	1.07	Yes
22.	*Help*	[hel.p^{h}]	4.04	0.82	N/A
		[ˈhel.p^{h}ʊ]	3.14	1.27	Yes
		[help]	2.88	1.33	Yes
		[hel]	1.88	0.95	Yes
23.	*Hence*	[hens]	3.68	0.98	N/A
		[hen.s]	3.44	0.98	Yes
		[hen]	1.35	0.60	Yes
		[hen.sɪ]	1.31	0.64	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
24.	*Inch*	[intʃ]	4.40	0.69	N/A
		[in.tʃ]	3.91	0.85	Yes
		[in]	1.50	0.65	Yes
		[ˈin.tʃi]	1.30	0.67	Yes
25.	*Kept*	[kep.t^{h}]	4.11	0.88	N/A
		[kept]	3.34	1.35	Yes
		[kep]	2.20	1.07	Yes
		[ˈkep.t^{h}ə]	1.41	0.66	Yes
26.	*Lapse*	[læps]	4.10	0.87	N/A
		[læp.s]	3.55	1.06	Yes
		[ˈlæ.p^{h}ʊs]	3.25	1.00	Yes
		[læs]	2.71	1.21	Yes
		[læp]	1.63	0.78	Yes
27.	*Lift*	[lɪft]	4.22	0.85	N/A
		[lif.t^{h}]	3.71	0.87	Yes
		[lɪf]	2.33	0.99	Yes
		[ˈlif.t^{h}ə]	1.57	0.68	Yes
28.	*Lisp*	[lɪsp]	3.81	1.09	N/A
		[lɪs.p^{h}]	3.20	1.09	Yes
		[lɪs]	2.45	1.01	Yes
		[ˈlɪs.p^{h}ʊ]	2.00	0.88	Yes
		[lɪps]	1.90	1.14	Yes
29.	*Melt*	[melt]	4.24	0.79	N/A
		[mel.t^{h}]	3.54	0.92	Yes
		[ˈmel.t^{h}ə]	1.50	0.69	Yes
		[mel]	1.47	0.75	Yes
30.	*Milk*	[mɪlk]	3.78	1.17	N/A
		[mɪl.k^{h}]	3.05	1.21	Yes
		[ˈmɪl.k^{h}ə]	2.41	0.94	Yes
		[mɪl]	1.97	0.88	Yes
		[mɪk]	1.11	0.38	Yes
31.	*Puffs*	[p^{h}ʌf.s]	3.73	0.84	N/A
		[p^{h}ʌfs]	3.61	0.92	No
		[p^{h}ʌf]	2.21	0.92	Yes
		[ˈp^{h}ʌ.fʊs]	1.98	0.90	Yes
32.	*Range*	[ɹeɪndʒ]	4.27	0.80	N/A
		[ɹeɪn.dʒ]	1.78	0.90	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
33.	*Rent*	[ɹen.t̩^{h}]	4.16	0.78	N/A
		[ɹent^{h}]	3.81	1.02	Yes
		[ˈɹen.t^{h}ə]	2.17	0.91	Yes
		[ɹen]	2.01	0.90	Yes
34.	*Self*	[self]	3.96	0.92	N/A
		[sel.f]	3.60	0.96	Yes
		[ˈsel.fʊ]	1.84	0.83	Yes
		[sel]	1.56	0.80	Yes
35.	*Shelve*	[ʃelf]	3.33	1.08	N/A
		[ʃel.f]	3.28	1.10	No
		[ʃelv]	2.58	1.09	Yes
		[ʃel]	1.64	0.74	Yes
36.	*Welsh*	[welʃ]	4.02	0.93	N/A
		[wel.ʃ]	3.95	0.85	NO
		[wel]	1.50	0.70	Yes
		[ˈwel.ʃɪ]	1.40	0.70	Yes

B. The average preference ratings of the stimuli testing final devoicing

The table in (A6-2) shows the 129 Hong Kong subjects' preference ratings for the variants that produce or not produce final obstruent devoicing (cf. Appendix 5).

(A6-2) Average preference ratings of the stimuli testing final obstruent devoicing

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
1.	*Begged*	[bek^{h}t^{h}]	3.93	0.94	N/A
		[begd]	3.88	1.02	No
2.	*Bronze*	[bɹɒnz]	3.80	0.95	N/A
		[bɹɒns]	3.66	1.02	No
3.	*Build*	[bɪlt^{h}]	3.97	0.86	N/A
		[bɪld]	3.72	1.14	Yes
4.	*Bulb*	[bʌlb]	3.48	1.13	N/A
		[bʌlp^{h}]	2.85	1.15	Yes
5.	*Clubbed*	[k^{h}lʌp^{h}t^{h}]	3.71	1.06	N/A
		[k^{h}lʌbd]	3.11	1.28	Yes
6.	*Hubs*	[hʌp^{h}s]	4.02	0.96	N/A
		[hʌbz]	3.13	1.09	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
7.	*Lend*	[lentʰ]	4.02	0.85	N/A
		[lend]	4.00	0.92	No
8	*Lived*	[lɪftʰ]	4.20	0.83	N/A
		[lɪvd]	3.67	1.14	Yes
9.	*Range*	[ɹeɪndʒ]	4.27	0.80	N/A
		[ɹeɪntʃ]	3.69	0.99	Yes
10.	*Shelve*	[ʃelf]	3.33	1.08	N/A
		[ʃelv]	2.58	1.09	Yes

Appendix 7
Average Preference Ratings of the Stimuli in the Attitudinal Test
(the Guangzhou Study)

A. The average preference ratings of the stimuli testing consonant clusters

Following the same presentation method in Appendix 6, (A7-1) shows the average preference ratings made by the 66 Guangzhou participants towards the phonetic variants that represent different ways of producing consonant clusters.

(A7-1) Average preference ratings of the stimuli testing consonant clusters

No.	Tested words	Variant stimuli	Means	Standard deviation	Whether significantly lower than the highest one ($p < 0.05$)
1.	*Clear*	[kʰlɪə]	4.39	0.76	N/A
		[kʰə.ˈlɪə]	3.64	1.33	Yes
		[kʰ.lɪə]	1.27	0.54	Yes
		[kʰɪə]	1.20	0.53	Yes
2.	*Cry*	[kʰɹaɪ]	3.97	1.02	N/A
		[kʰ.ɹaɪ]	2.86	1.23	Yes
		[kʰə.ˈɹaɪ]	2.71	1.16	Yes
		[kʰaɪ]	1.17	0.48	Yes
3.	*Fly*	[flaɪ]	4.06	1.09	N/A
		[fu.ˈlaɪ]	3.35	1.18	Yes
		[f.laɪ]	2.44	1.15	Yes
		[faɪ]	1.52	0.92	Yes
4.	*Frank*	[fɹæŋk]	3.88	1.13	N/A
		[fu.ˈɹæŋk]	3.15	1.14	Yes
		[fæŋk]	2.91	1.59	Yes
		[f.ɹæŋk]	1.91	1.00	Yes
5.	*Pray*	[pʰɹeɪ]	2.55	1.46	N/A
		[pʰ.ɹeɪ]	2.24	1.04	No
		[pʰu.ˈɹeɪ]	2.20	1.41	No
		[pʰeɪ]	1.26	0.56	Yes
6.	*Scratch*	[skɹætʃ]	4.70	0.58	N/A
		[s.kɹætʃ]	3.86	1.07	Yes
		[skə.ˈɹætʃ]	2.45	1.07	Yes
		[skætʃ]	1.79	1.05	Yes
7.	*Skate*	[skeɪt]	3.53	1.29	N/A
		[s.keɪt]	2.17	1.18	Yes
		[seɪt]	1.23	0.58	Yes
		[sɪ.ˈkeɪt]	1.14	0.46	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
8.	*Smoke*	[smoʊk]	4.79	0.51	N/A
		[s.moʊk]	3.23	1.26	Yes
		[sɪ.ˈmoʊk]	1.27	0.57	Yes
		[soʊk]	1.20	0.47	Yes
9.	*Speak*	[spiːk]	4.00	1.15	N/A
		[s.piːk]	3.42	1.31	Yes
		[sɪ.ˈpiːk]	1.23	0.70	Yes
		[siːk]	1.06	0.30	Yes
10.	*Split*	[splɪt]	3.97	1.18	N/A
		[s.plɪt]	3.30	1.25	Yes
		[spu.ˈlit]	3.11	1.23	Yes
		[spɪt]	1.68	0.95	Yes
11.	*Spring*	[spɹɪŋ]	4.17	0.94	N/A
		[s.pɹɪŋ]	3.38	1.17	No
		[spʊ.ˈɹɪŋ]	3.00	1.08	Yes
		[spɪŋ]	1.36	0.76	Yes
12.	*Stay*	[s.teɪ]	2.74	1.24	N/A
		[steɪ]	2.20	1.23	Yes
		[seɪ]	1.22	0.60	Yes
		[sɪ.ˈteɪ]	1.20	0.64	Yes
13.	*AIDS*	[eɪs]	3.31	1.17	N/A
		[eɪdz]	2.86	1.38	Yes
14.	*Ask*	[ɑ:skʰ]	4.43	0.84	N/A
		[ɑ:s.kʰ]	4.11	1.04	No
		[ɑ:s]	2.76	1.10	Yes
		[ˈɑ:s.kʰə]	2.06	1.00	Yes
15.	*Bronze*	[bɹɒnz]	4.14	0.93	N/A
		[bɹɒn.s]	3.94	0.97	No
16.	*Camp*	[kʰæm.pʰ]	4.38	0.91	N/A
		[kʰæmp]	4.21	1.03	No
		[kʰæm]	2.89	1.23	Yes
		[ˈkʰæm.pʰə]	2.59	1.26	Yes
17.	*East*	[iːstʰ]	3.77	1.27	N/A
		[iːs.tʰ]	3.18	1.14	Yes
		[iːs]	2.21	1.02	Yes
		[ˈiːs.tʰə]	1.92	0.93	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
18.	*Eats*	[i:ts]	3.77	1.15	N/A
		[i:s]	2.71	1.15	Yes
		[i:t]	2.36	1.08	Yes
19.	*Else*	[els]	4.35	0.79	N/A
		[el.s]	4.14	0.99	No
		[el]	1.53	0.85	Yes
		[ˈel.si]	1.52	0.88	Yes
20.	*Fact*	[fækʰtʰ]	4.58	0.82	N/A
		[fætʰ]	3.82	1.26	Yes
		[fæk.tʰ]	2.98	1.26	Yes
		[fækʰ]	2.76	1.18	Yes
		[ˈfæk.tʰə]	2.03	1.05	Yes
21.	*Frank*	[fɹæŋ.kʰ]	4.21	1.03	N/A
		[fɹæŋkʰ]	3.88	1.13	No
		[ˈfɹæŋ.kʰə]	2.85	1.32	Yes
		[fɹæŋ]	2.68	1.23	Yes
22.	*Help*	[hel.pʰ]	4.32	0.75	N/A
		[help]	2.74	1.29	Yes
		[ˈhel.pʰʊ]	2.59	1.35	Yes
		[hel]	2.41	1.08	Yes
23.	*Hence*	[hens]	4.35	0.79	N/A
		[hen.s]	3.89	0.99	Yes
		[hen.sɪ]	2.00	0.98	Yes
		[hen]	1.52	0.77	Yes
24.	*Inch*	[intʃ]	4.55	0.71	N/A
		[in.tʃ]	4.05	0.94	Yes
		[ˈin.tʃi]	1.55	0.73	Yes
		[in]	1.38	0.63	Yes
25.	*Kept*	[kep.tʰ]	4.29	0.84	N/A
		[kept]	3.65	1.36	Yes
		[kep]	2.41	0.98	Yes
		[ˈkep.tʰə]	1.62	0.87	Yes
26.	*Lapse*	[læps]	4.30	0.91	N/A
		[læp.s]	3.94	0.96	Yes
		[læs]	3.52	1.32	Yes
		[ˈlæ.pʰʊs]	3.52	1.06	Yes
		[læp]	2.03	0.91	Yes

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
27.	*Lift*	[lɪft]	4.59	0.61	N/A
		[lif.tʰ]	3.80	1.06	Yes
		[lɪf]	2.36	1.06	Yes
		[ˈlif.tʰə]	2.03	0.99	Yes
28.	*Lisp*	[lɪsp]	4.42	0.86	N/A
		[lɪs.pʰ]	2.89	1.29	Yes
		[lɪs]	2.55	1.11	Yes
		[ˈlɪs.pʰʊ]	1.98	1.05	Yes
		[lɪps]	1.97	1.16	Yes
29.	*Melt*	[melt]	4.35	0.89	N/A
		[mel.tʰ]	4.11	0.83	Yes
		[mel]	1.88	0.81	Yes
		[ˈmel.tʰə]	1.82	0.88	Yes
30.	*Milk*	[mɪlk]	4.03	1.07	N/A
		[mɪl.kʰ]	2.71	1.27	Yes
		[ˈmɪl.kʰə]	2.39	1.15	Yes
		[mɪl]	2.26	1.00	Yes
		[mɪk]	1.36	0.69	Yes
31.	*Puffs*	[pʰʌf.s]	4.17	0.90	N/A
		[pʰʌfs]	4.06	0.99	No
		[pʰʌf]	2.32	1.07	Yes
		[ˈpʰʌ.fʊs]	2.14	1.02	Yes
32.	*Range*	[ɹeɪndʒ]	4.36	0.91	N/A
		[ɹeɪn.dʒ]	1.86	1.02	Yes
33.	*Rent*	[ɹen.t̩ʰ]	4.35	0.83	N/A
		[ɹentʰ]	4.08	0.95	No
		[ˈɹen.tʰə]	2.55	1.34	Yes
		[ɹen]	1.98	0.85	Yes
34.	*Self*	[self]	4.38	0.84	N/A
		[sel.f]	4.18	0.91	No
		[sel]	2.20	1.04	Yes
		[ˈsel.fʊ]	2.14	1.08	Yes
35.	*Shelve*	[ʃelf]	4.05	1.10	N/A
		[ʃel.f]	3.45	1.25	Yes
		[ʃelv]	2.95	1.35	Yes
		[ʃel]	2.23	1.13	Yes
36.	*Welsh*	[wel.ʃ]	4.35	0.92	N/A
		[welʃ]	3.92	1.17	Yes
		[ˈwel.ʃɪ]	1.82	1.02	Yes
		[wel]	1.65	0,83	Yes

B. The average preference ratings of the stimuli testing final devoicing

The table in (A7-2) shows the 66 Guangzhou people's average preference ratings for the variant stimuli related to final obstruent devoicing (cf. Appendix 5).

(A7-2) Average preference ratings of the stimuli testing final obstruent devoicing

No.	Tested words	Variant stimuli	Means	Standard deviations	Whether significantly lower than the highest one ($p < 0.05$)
1.	*Begged*	[bek^{h}t^h]	4.31	0.88	N/A
		[begd]	4.29	0.92	No
2.	*Bronze*	[bɹɒnz]	4.13	0.93	N/A
		[bɹɒns]	4.05	0.94	No
3.	*Build*	[bɪlt^h]	4.36	0.92	N/A
		[bɪld]	4.08	1.01	No
4.	*Bulb*	[bʌlb]	4.08	1.19	N/A
		[bʌlp^h]	4.00	1.11	No
5.	*Clubbed*	[k^{h}lʌp^{h}t^h]	3.98	1.16	N/A
		[k^{h}lʌbd]	3.92	1.10	No
6.	*Hubs*	[hʌp^{h}s]	4.35	0.85	N/A
		[hʌbz]	2.68	1.27	Yes
7.	*Lend*	[lent^h]	4.21	1.14	N/A
		[lend]	4.17	1.06	No
8	*Lived*	[lɪft^h]	4.62	0.65	N/A
		[lɪvd]	3.29	1.27	Yes
9.	*Range*	[ɹeɪndʒ]	4.36	0.90	N/A
		[ɹeɪntʃ]	3.39	1.39	Yes
10.	*Shelve*	[ʃelf]	4.05	1.10	N/A
		[ʃelv]	2.95	1.35	Yes

Appendix 8

List of Transcriptions for Each Hong Kong Informant in the Production Test[♠]

I. HK-F-23-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹeit	dfɹei.a	ʌ.fɹeit	tə.fɹei.aː	ə.fɹeit	t.fɹei.aː
2.	*age*	eitʃ	tʃ.ei	eitʃ	tʃ.ei	eitʃ	tʃ.ei
3.	*Alps*	elps	s.el	elps	s.el	elps	s.elp
4.	*amuse*	ʌ.mius	smiu.ə	ʌ.mius	smiu.ʌ	ʌ.mius	smiu.ʌ
5.	*anguish*	eŋ.gwiʃ	ʃgwi.en	eŋ.gwiʃ	ʃgwi.en	en.gwiʃ	ʃgwi.en
6.	*anklet*	eŋ.klet	tlek.en	eŋ.klet	klət.en	eŋ.klet	tklə.en
7.	*ant*	ænt	t.æn	ent	t.en	ent	t.en
8.	*approve*	ə.pɹuːf	fpɹu.a	ʌ.pɹuːf	fpɹu.a	ə.pɹuːf	fpɹu.aː
9.	*ask*	ask	kəs.aː	ask	kəs.aː	ask	ks.aː
10.	*asked*	askt	təks.aː	askt	tks.aː	askt	tks.aː
11.	*asks*	asks	sks.aː	asks	sks.aː	asks	sks.aː
12.	*bangs*	bæŋs	sbæŋ	bæŋs	sbæŋ	bæŋs	sbæŋ
13.	*begged*	beːkt	tkbeː	bekt	tkbe	bekt	tkbe
14.	*begs*	beks	sbe	beks	sbek	beks	sbe
15.	*blast*	blast	tsis.laːp	blast	təs.blaː	blast	tsblaː
16.	*bled*	blet	dlep	blet	dlep	blet	tble

[♠] The data are from the research project supported by the grant GRFHKBU250712 (P.I.: Lian-Hee Wee).

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
17.	*bloom*	blum	lump	blum	lump	blum	lumb
18.	*blunt*	blənt	tlənp	blənt	tbən	blʌnt	tblʌn
19.	*blur*	bləː	ləːp	bləːɹ	ləːɹp	bləːɹ	ləːɹp
20.	*brief*	bɹif	fwip	bɹif	fbɹiː	bɹif	fbɹiː
21.	*Britain*	bɹi.tən	tən.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi
22.	*bronze*	bɹoŋs	sbɹoŋ	bɹoŋs	sbɹoŋ	bɹoŋs	sbɹoŋ
23.	*build*	biut	t.iup	biut	tbiu	biut	tbiu
24.	*bulb*	bʌp	p.ʌp	$bʌp^h$	bʌp	$bʌp^h$	p.bʌp
25.	*bulbs*	bʌps	sbʌp	bʌps	sbʌp	bʌps	sbʌp
26.	*cashback*	kæʃ.bæk	kbæʃ.kæ	kæʃ.bæk	kbæʃ.kæ	kæʃ.bæk	kbæʃ.kæ
27.	*clarify*	ke.ɹi.fai	fai.ɹi.kle	klæ.wi.fai	fai.ɹi.kle	klæ.ɹə.fai	fai.ɹi.klæ
28.	*Clark*	klak	klak	klak	klak	klak	k.kla
29.	*clear*	kliə	ʌ.kliː	kliə	ə.kliː	kliə	ə.kliː
30.	*cliff*	klif	fkli	klif	fkli	klif	fkli
31.	*close*	klous	sklou	klous	sklou	klous	sklou
32.	*closure*	klou.ʃə	ʃə.klou	$klou.s^wə$	$s^wə.klou$	$klou.s^wə$	$s^wə.klou$
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou
34.	*clubbed*	klʌpt	tklʌp	klʌpt	tklʌp	klʌp	tklʌp
35.	*Constantine*	kons.tən.tin	tin.tən.skon	kons.tən.tin	tin.tən.skon	kons.tən.tin	tin.tən.skon
36.	*corpse*	kops	skop	kops	skop	kops	skop
37.	*crawl*	kɹoː	ɹok	kɹoː	ɹoːk	kɹou	ou.kɹoː
38.	*crisp*	kɹipsp	pskɹip	kɹips	skɹip	kɹisp	pskɹi
39.	*crow*	kɹou	oukɹ	kɹou	oukɹ	kɹou	oukɹ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
40.	*crown*	kɹoŋ	ɹoŋk	kɹaŋ	ɹaŋk	kɹoŋ	ɹoŋk
41.	*cry*	kɹai	aikɹ	kɹai	aikɹ	kɹai	aikɹ
42.	*cube*	kjup	pkju	kjup	pkiu	kiup	pkiu
43.	*digest*	dʌi.dʒest	ts.dʒe.dʌi	dʌi.dʒest	təs.dʒe.dʌi	dʌi.dʒest	təs.dʒe.dʌi
44.	*disband*	dis.ben	ben.sdi	dis.bent	bens.di	dis.ben	bens.di
45.	*disclaim*	dis.kleim	keims.di	dis.klem	klems.di	dis.klem	klems.di
46.	*discuss*	dis.gʌs	skʌ.sdi	dis.kʌs	skʌ.sdi	dis.kʌs	skʌ.sdi
47.	*dumped*	dʌmt	tə.dʌm	dʌmt	tdʌm	dʌmt	tdʌm
48.	*east*	ist	ts.i	ist	ts.iː	ist	ts.iː
49.	*eats*	is	s.it	its	s.it	its	s.it
50.	*Ed*	et	t.e	et	t.e	et	t.e
51.	*edge*	etʃ	ʃ.e	etʃ	tʃ.e	etʃ	tʃ.e
52.	*elf*	elf	f.el	elf	f.el	elf	f.el
53.	*else*	els	s.el	els	s.el	els	s.el
54.	*elves*	elfs	sf.el	elfs	sf.el	elfs	sf.el
55.	*encourage*	en.kʌ.ɹeitʃ	tʃɹei.kə.ən	eŋ.kə.ɹeitʃ	tʃɹei.kə.en	eŋ.kʌ.ɹeitʃ	tʃɹei.kə.en
56.	*encouraging*	en.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kə.en	iŋ.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹei.kə.en	eŋ.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹei.kə.en
57.	*English*	iŋ.gliʃ	ʃgli.iŋ	iŋ.gliʃ	ʃgli.iŋ	iŋ.gliʃ	ʃgli.iŋ
58.	*ex-con*	eks.kon	kons.ek	eks.kon	kons.ik	eks.kon	kons.ik
59.	*excuse*	es.gius	sgius.ik	iks.kius	skius.ik	iks.kius	skius.ik
60.	*exhale*	eks.hei.əl	ou.heis.ik	eks.hel	ou.heːs.ik	eks.heː.əl	ou.heis.ik
61.	*explode*	eks.blout	də.blous.ik	es.blout	də.blous.ik	es.plout	tblous.ik
62.	*fabric*	fæ.bɹik	ɹik.fæp	fæ.bɹik	bɹi.fæp	fæ.bɹik	bɹi.fæp

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
63.	*fact*	fækt	tfæ	fækt	tfæ	fækt	tfæ
64.	*famed*	femt	tfem	femt	tfem	femt	tfem
65.	*fed*	fet	dfeː	fet^{h}	tfe	fet	tə.fe
66.	*film*	fim	imf	fim	iɱf	fim	iɱf
67.	*fish*	fiʃ	ʃfi	fiʃ	ʃfi	fiʃ	ʃfi
68.	*flap*	flæp	blæf	flæp	læff	flæp	pflæ
69.	*flirt*	fləɹt	tləɹf	flət	tləf	flət	tfləɹ
70.	*flu*	fluː	luːf	fluː	luːf	fluː	luːf
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fuː.liʃ	ʃli.fuː	fu.liʃ	ʃli.fuː	fu.liʃ	ʃli.fuː
73.	*frank*	fɹeŋk	kfɹen	fɹeŋk	kfɹen	fɹeŋk	kfɹen
74.	*Franks*	fɹeŋks	skfɹen	fɹeŋs	sfɹeŋ	fɹeŋks	sfɹeŋk
75.	*free*	fɹiː	ɹif	fɹiː	iːf	fɹiː	ɹiːf
76.	*freshness*	fɹeʃ.nis	snəʃ.fɹe	fɹeʃ.nis	snəʃ.fɹe	fɹeʃ.nəs	snəʃ.fɹe
77.	*friend*	fɹent	d.enf	fɹent	tfɹen	fɹent	tfɹen
78.	*fringe*	fɹintʃ	tʃɹinf	fɹintʃ	tʃfɹin	fɹintʃ	tʃfɹin
79.	*games*	gems	sgem	gems	sgem	gems	sgem
80.	*gasped*	gaspt	tpsgaː	gaspt	tpsga	gæspt	tpsgæ
81.	*gasps*	gasps	spsgaː	gasps	spsgap	gæsps	spsgæp
82.	*gave*	geif	fgei	geːf	fgei	geif	fgei
83.	*glue*	gluː	ə.luːk	gluː	ə.gluː	gluː	ə.gluː
84.	*grab*	gɹep	bgɹep	gɹæp^{h}	bgɹap	gɹæp^{h}	pgɹæ
85.	*grant*	gɹʌnt	tgɹaŋ	gɹant	tgɹaŋ	gɹʌnt	tgɹaŋ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
86.	*grape*	gɹeip	pɹeik	gɹeip	pgɹei	gɹeip	pgɹei
87.	*help*	help	phel	help	phel	help	phel
88.	*helped*	helpt	thel	helpt	thelp	helpt	thel
89.	*hobnob*	hop.no	hop.hop	hop.nop	nop.hop	hop.nop	nop.hop
90.	*implore*	im.ploː.əɹ	əɹ.ploː.im	im.ploː.ə	ʌ.ploː.im	im.ploː.ə	ʌ.ploː.im
91.	*improve*	im.pɹuːf	fpɹu.im	im.pɹuːf	fpɹu.im	im.pɹuːf	fpɹu.im
92.	*inch*	intʃ	tʃ.in	intʃ	tʃ.iŋ	intʃ	tʃ.iŋ
93.	*increasing*	in.kɹiː.siŋ	siŋ.kɹiː.in	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fi.nit	tnə.fən.de.in	in.de.fə.nit	tnə.fən.de.in	in.de.fi.nit	tnə.fən.de.in
95.	*independent*	in.di.pen.dənt	tdən.pen.di.in	in.di.pen.dənt	dənt.pen.di.in	in.di.pen.dənt	tdən.pen.di.in
96.	*inflict*	in.flit	tlif.in	in.flit	flit.in	in.flit	tfli.in
97.	*infuse*	in.fius	sfiu.in	in.fius	sfiu.in	in.fius	sfiu.in
98.	*ink*	iŋk	kiŋ	iŋk	k.iŋ	iŋk	k.iŋ
99.	*inked*	iŋkt	tk.iŋ	iŋkt	tk.iŋ	iŋkt	tk.iŋ
100.	*inks*	iŋs	sgiŋ	iŋs	s.iŋ	iŋs	s.iŋ
101.	*instinct*	ins.tiŋt	diŋs.in	ins.tiŋt	diŋs.in	ins.diŋt	tdiŋs.in
102.	*instrument*	ins.tɹu.mənt	tmən.tɹus.in	ins.tɹu.mənt	tmən.tɹus.in	ins.tɹu.mənt	tmən.tɹus.in
103.	*i-Tunes*	ai.tuns	stun.ai	ai.tuns	stun.ai	ai.tuns	stun.ai
104.	*jasmine*	dʒʌs.mən	məns.dʒʌː	dʒʌs.mən	məns.dʒæ	dʒʌs.mən	məns.dʒæ
105.	*jumps*	dʒʌms	sdʒʌm	dʒʌms	sdʒʌm	dʒʌms	sdʒʌm
106.	*kept*	kept	tkep	kept	tkep	kept	tkep
107.	*lapse*	læps	slæp	læps	slæp	læps	slæp
108.	*lapsed*	læpst	təs.læːp	læpst	təs.læp	læpst	tslæp

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
109.	*larks*	laɹks	slak	laks	slak	laks	slak
110.	*lend*	lent	dlen	lent	tlen	lent	tlen
111.	*lift*	lift	tsif.liː	lift	tfliː	lift	tfli
112.	*lisp*	lisp	pəs.li	lisp	pəs.li	lisp	psli
113.	*lived*	lift	tfli	lift	təf.liː	lift	tfli
114.	*lives*	laifs	sflai	laifs	sflai	laifs	sflai
115.	*lock*	lok	klo	lok	klo	lok	klo
116.	*log*	log	ə.lo	lo	ol	log	glo
117.	*lump*	ləmp	pləm	lʌmp	pləm	lʌmp	plʌm
118.	*matched*	mæʃt	t.tʃ.mæ	mætʃt	tətʃ.mæː	mætʃt	t.tʃ.mæ
119.	*melt*	melt	tmel	melt	tmel	melt	tmel
120.	*milk*	milk	kmiu	milk	kmiu	milk	kmiu
121.	*misquote*	mis.kwout	tkwous.mi	mis.kwout	tkwous.mi	mis.kwout	tkwous.mi
122.	*ounce*	ons	s.on	ons	s.on	ons	s.on
123.	*owns*	oŋs	s.oŋ	oŋs	s.oŋ	oŋs	s.oŋ
124.	*ox*	oks	s.ok	os	s.o	os	s.o
125.	*participate*	pa.ti.sə.peit	t.pei.sə.ti.pa	pa.ti.sə.peit	pei.si.ti.pa	pa.ti.sə.peit	tpei.si.ti.pa
126.	*peacemaking*	pis.mek.kiŋ	kiŋ.mek.spiː	pis.mek.kiŋ	kiŋ.mek.spiː	pis.mek.kiŋ	kiŋ.mek.spiː
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	eipɹ
129.	*presidency*	pɹe.si.dən.si	si.dən.sə.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	sfpʌp	pʌfs	sfpʌp	pʌfs	spʌf
131.	*raised*	ɹeist	dsɹei	ɹeist	təs.ɹei	ɹeist	təs.ɹei

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
132.	*range*	ɹeintʃ	tʃɹein	ɹeŋtʃ	tʃweŋ	ɹeŋtʃ	tʃɹeŋ
133.	*recommend*	ɹe.kəm.ment	meŋ.ken.ɹe	ɹe.kəm.ment	men.ken.ɹe	ɹe.kəm.ment	men.kem.ɹe
134.	*recruiter*	ɹi.kɹu.tʌ	tə.kɹu.ɹi	ɹi.kɹi.tʌ	tə.kɹut.ɹi	ɹi.kɹu.tʌ	tə.kɹu.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹei.dʒə.fəɹ.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹe.dʒu.ɹei.tə	tə.ɹei.dʒə.fu.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tei.tif	fti.tei.sem.pɹi.ɹe	ɹe.pɹi.sen.ti.tif	f.ti.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	f.tə.tə.sem.pɹi.ɹe
138.	*rushed*	ɹʌʃt	təʃ.ɹʌt	ɹʌʃt	təʃ.ɹʌt	ɹʌʃt	təʃ.ɹʌt
139.	*scratch*	sgɹetʃ	tʃgɹes	skɹetʃ	tʃkɹes	skɹetʃ	tʃkɹes
140.	*scree*	skɹiː	iːks	skɹiː	kɹiːs	skɹiː	kɹiːs
141.	*segment*	se.mənt	tmən.se	seʔ.mənt	tmən.se	seʔ.mənt	tmən.se
142.	*senseless*	sens.les	sles.sen	sens.les	sles.sen	sens.nəs	sles.sen
143.	*sequence*	si.kwəns	skwən.siː	si.kwəns	skwən.siː	si.kwəns	skwən.siː
144.	*shameless*	ʃem.les	sle.emʃ	ʃem.les	sle.ʃem	ʃem.les	sne.ʃem
145.	*shelve*	ʃelf	fʃel	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelft	tfʃel	ʃelft	dəf.ʃel	ʃelft	tfʃel
147.	*skate*	sgeit	tgeis	sgeit	tgeis	sgeit	tgeis
148.	*skating*	sgei.tiŋ	tiŋ.geis	skei.tiŋ	tiŋ.keis	skeː.tiŋ	tiŋ.geis
149.	*slope*	slup	lups	slup	lups	slup	plups
150.	*small*	smoː	moːs	smoː	moːs	smoː	mos
151.	*smooth*	smuːθ	smuːθ	smuθ	muθs	smuθ	θmus
152.	*snatch*	snætʃ	ʃnæs	snætʃ	ʃnæs	snetʃ	tʃles
153.	*spa*	sbaː	aːps	sbaː	baɹs	spaː	paːs
154.	*spare*	speəɹ	ə.bes	speəɹ	ə.beːs	sbeəɹ	ə.beːs

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
155.	*sphere*	sfi.ə	ʌ.fis	sfiəɹ	ə.fis	sfiəɹ	ə.fis
156.	*spiritual*	sbi.ɹi.tʃou	tʃou.ɹi.bis	sbi.ɹi.tʃou	tʃou.ɹi.bis	sbi.ɹi.tʃou	tʃou.ɹi.bis
157.	*splendid*	sblen.dit	dip.blens	sblen.dit	t.t.blens	sblen.dit	t.t.blens
158.	*split*	sblit	tblis	sblit	tblis	sblit	tblis
159.	*spoil*	sbo.jəl	ou.bois	sbo.jəl	ou.bois	sbo.jəl	ou.bois
160.	*spray*	sbɹei	pɹeis	sbɹei	pɹeis	sbɹei	pɹeis
161.	*spring*	sbɹiŋ	wiŋps	spɹiŋ	pɹiŋs	spɹiŋ	bɹiŋs
162.	*springs*	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	spɹiŋs	spɹiŋs
163.	*squeeze*	sgwiːs	sgwiːs	sgwiːs	sgwiːs	sgwiːs	sgwiːs
164.	*stain*	sden	deŋs	steŋ	teŋs	steŋ	teŋs
165.	*star*	sdaːɹ	daːɹs	sdaː	daːɹs	sdaːɹ	daːɹs
166.	*string*	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs	sdɹiŋ	tɹiŋs
167.	*stupid*	stju.pit^h	tə.pi.tjuːs	sdju.bit^h	pi.djus	stju.pit^h	tpdjus
168.	*suppose*	sə.pous	spou.sə	sə.pous	spou.sə	sə.pous	spou.sə
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	test	tste	test	tsste	test	tsste
171.	*thankful*	θeŋk.fou	fou.θeŋk	θeŋk.fou	fou.θeŋk	θenk.fou	fou.θenk
172.	*trenched*	tɹentʃt	t.tʃ.tʃen	tɹentʃt	tətʃ.tɹen	tɹentʃt	ttʃtɹen
173.	*tweet*	twit	t.wit	twit	t.twi	twit	t.twi
174.	*underpaid*	ʌn.də.pei	də.pei.də.ʌn	ʌn.də.peit	pei.də.ʌn	ʌn.də.peit	pei.də.ʌn
175.	*understand*	ʌn.də.sdæn	dens.də.ʌn	ʌn.də.sdænt	t.tæn.stə.ʌn	ʌn.də.stænt	tæn.stə.ʌn
176.	*urge*	əʃ	tʃ.əɹ	əɹtʃ	tʃ.əːɹ	əːtʃ	dʒ.əː
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃ.wel	welʃ	ʃ.wel

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
178.	*whereabout*	weə.ɹə.baut	tbau.wə.ə.we	weə.ɹə.baut	baut.ɹə.ɹe	weə.ɹə.baut	tbau.ɹə.weː
179.	*wolf*	woːf	f.wuː	wuːf	f.wuː	wof	f.woː
180.	*woodland*	wut.lent	tlen.twut	wud.len	len.wut	wut.len	lent.wut

II. HK-F-24-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹeit	tfɹei.ʌ	ʌ.fɹeit	fɹeit.ʌ	ʌ.fɹeit	fɹeid.ʌ
2.	*age*	eitʃ	tʃei	eitʃ	tʃei	eitʃ	tʃ.ei
3.	*Alps*	elps	selp	elps	selp	elps	sel
4.	*amuse*	ʌ.mius	sz̩.miu.ʌ	ʌ.mius	smiu.ʌ	ʌ.mius	mius.ʌ
5.	*anguish*	eŋ.gwiʃ	ʃgwə.en	eŋ.gwiʃ	gwiʃ.en	eŋ.gwiʃ	gwiʃ.en
6.	*anklet*	æŋk.let	let.æŋk	eŋk.let	let.eŋk	eŋk.let	let.eŋk
7.	*ant*	ænt	tæn	ten	ten	ent	ten
8.	*approve*	ʌ.pɹuf	f̩.pɹu.ʌ	ʌ.pɹuf	pɹuf.ʌ	ʌ.pɹuf	pɹuf.ʌ
9.	*ask*	ask	kə.sʌ	ask	kas	ask	kas
10.	*asked*	askt	dək.sa	askt	dək.as	aːskt	dək.as
11.	*asks*	asks	sk.as	ass	sas	asks	sks.a
12.	*bangs*	bæŋks	sæŋb	bæŋks	sæŋp	bæŋs	sæŋp
13.	*begged*	bekt	dək.be	bekt	dək.be	be.gət	dək.be
14.	*begs*	peks	sep	beks	sep	beks	sep
15.	*blast*	blast	sɯ.lab	blʌst	tʌsp	blast	stblaː
16.	*bled*	bled	teb	blet	dep	blet	dleb
17.	*bloom*	blum	mub	blum	lump	bluːm	luːmp
18.	*blunt*	blʌnt	tsʌnb	blʌnt	tʌnp	blʌnt	tʌnp
19.	*blur*	blə	ləb	bləː	ləːp	bləːɹ	ləːp
20.	*brief*	bɹif	fɹib	bɹiːf	fɹiːb	bɹif	fɹib
21.	*Britain*	bɹi.tən	tən.bɹi	bɹi.tən	tən.bɹi	bɹi.tən	tən.bɹi
22.	*bronze*	bɹans	sɹʌ	bɹons	sɹonp	bɹans	sbɹan

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	djub	biut	diup	biut	diup
24.	*bulb*	bʌb	bʌb	bʌb	bʌb	bop	bop
25.	*bulbs*	bʌps	spʌp˺	bʌps	sbʌp	bʌps	sbʌp
26.	*cashback*	kæʃ.bæk	kə.bæʃ.kæ	kæʃ.bæk	bækʃ.kæ	kæʃ.bæk	bæʃ.kæ
27.	*clarify*	kle.ɹi.fai	fai.ɹi.kle	kle.ɹi.fʌi	fʌi.ɹi.kle	kle.ɹi.fʌi	fʌi.ɹi.kle
28.	*Clark*	klak	kɹak	klak	lak	klak	klak
29.	*clear*	kliə	ʌ.kli	kliʌ	ʌ.kli	kliʌ	ʌ.kli
30.	*cliff*	klif	fkli	klif	flik	klif	lifk
31.	*close*	klous	sklou	klous	lousk	klous	sklou
32.	*closure*	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou
34.	*clubbed*	klʌ.pət	pət.klʌ	klʌ.bət	bət.klʌp	klʌ.bət	dəp.klʌp
35.	*Constantine*	kons.tə.tin	tin.təs.kon	koŋ.stən.tin	tiŋ.ten.skoŋ	koŋ.stən.tin	tiŋ.ten.skoŋ
36.	*corpse*	kops	sko	kops	sko	kops	sko
37.	*crawl*	kɹoː	loːk	kɹoː	loːk	kɹoː	loːk
38.	*crisp*	kɹisp	skɹi	kɹisp	spkɹi	kɹisp	spkɹi
39.	*crow*	kɹou	wouk	kɹou	ɹouk	kɹou	ɹouk
40.	*crown*	kɹaun	ɹaunk	kɹaun	ɹaunk	kɹaun	ɹaŋk
41.	*cry*	kɹʌi	ʌik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kjup	bə.kju	kjup	bjuk	kjup	bjuk
43.	*digest*	dʌi.dʒest	tʂ.dʒe.dʌi	dʌi.dʒest	sdʒeː.dʌi	dʌi.dʒest	dʒest.dʌi
44.	*disband*	dis.bent	dem.sdi	dis.bent	bens.di	dis.bent	bens.di
45.	*disclaim*	dis.kleim	eim.sdi	dis.kleim	kleim.sdi	dis.kleim	kleim.sdi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	skʌ.sdi	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌmpt	tə.dʌm	dʌmpt	dəp.dʌm	dʌmpt	dəp.dʌm
48.	*east*	ist	sṭ.i	iːst	st.iː	iːst	st.iː
49.	*eats*	its	ṣ.i	its	si	its	si
50.	*Ed*	ed	de	et	deː	et	deː
51.	*edge*	etʃ	tʃe	etʃ	tʃe	etʃ	tʃe
52.	*elf*	elf	fle	elf	fel	elf	fel
53.	*else*	els	sel	els	sel	els	sel
54.	*elves*	elfs	sfel	elfs	sf.el	elfs	sf.el
55.	*encourage*	eŋ.kə.ɹeitʃ	ɹeitʃ.kə.en	eŋ.kə.ɹeitʃ	ɹeitʃ.kə.en	eŋ.kə.ɹeitʃ	ɹeitʃ.kə.en
56.	*encouraging*	iŋ.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.en	eŋ.kə.ɹei.dʒiŋ	dʒiŋ.ɹi.kə.en	eŋ.kə.ɹei.dʒiŋ	dʒiŋ.ɹei.kə.en
57.	*English*	iŋg.ləʃ	ʃ.glə.iŋ	iŋg.ləʃ	ləʃ.iŋk	iŋg.ləʃ	gləʃ.iŋ
58.	*ex-con*	iks.kon	kon.iks	eks.kon	kon.eks	eks.kon	kon.eks
59.	*excuse*	iks.gjus	skju.iks	iks.kjus	skjus.ik˺	iks.kjus	kjus.iks
60.	*exhale*	iks.hel	hel.iks	iks.hel	hel.iks	iks.hel	hel.eks
61.	*explode*	iks.blout	tə.blou.iks	iks.plout	də.plou.iks	iks.plout	plout.iks
62.	*fabric*	fe.bɹik	kip.fe	fe.bɹi	bɹik˺.fe	fe.bɹik	bɹik.feː
63.	*fact*	fæt	tæf	fæt	tækf	fekt	tekf
64.	*famed*	feimt	deimf	feimt	dəm.fei	feimt	deimf
65.	*fed*	fed	def	fet	def	fet	def
66.	*film*	fim	mfi	fim	mif	fim	mif
67.	*fish*	fiʃ	ʃif	fiʃ	ʃfiː	fiʃ	ʃif
68.	*flap*	flep	pef	flep	lepf	flep	pef

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flət	tɹəf	flət	təf	flət	təf
70.	*flu*	fluː	ju.luf	fluː	luf	fluː	luf
71.	*fly*	flʌi	ʌif	flʌi	lʌif	flʌi	lʌif
72.	*foolish*	fu.liʃ	ʃli.fu	fu.liʃ	ʃli.fu	fu.liʃ	ʃli.fu
73.	*frank*	fɹeŋk	kɹenf	fɹeŋk	kɹenf	fɹeŋk	kɹenf
74.	*Franks*	fɹeŋks	sɹeŋf	fɹeŋks	sɹeŋf	fɹeŋks	sɹeŋf
75.	*free*	fɹiː	iːf	fɹiː	if	fɹiː	ɹiːf
76.	*freshness*	fɹeʃ.nis	snɨʃ.fɹe	fɹeʃ.nes	sneʃ.feː	fɹeʃ.nəs	snəʃ.fɹeː
77.	*friend*	fɹent	dɹenf	fɹent	dɹenf	fɹent	dɹenf
78.	*fringe*	fɹintʃ	tʃu.ɹinf	fɹintʃ	tʃɹinf	fɹintʃ	tʃɹinf
79.	*games*	geims	seimg	gems	sgem	gems	sgem
80.	*gasped*	gespt	dəp.ges	gespt	dəps.geː	gespt	dəps.geː
81.	*gasps*	gasps	sps.ga	gesps	sps.ge	gesps	spsge
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	gluː	ug	gluː	lug	gluː	lug
84.	*grab*	gɹep	bɹeg	gɹep	bek	gɹep	bɹeg
85.	*grant*	gɹʌnts	tskɹʌn	gɹent	tɹenk	gɹʌnt	ɹaŋk
86.	*grape*	gɹeip	pə.gɹei	gɹeip	pə.gɹei	gɹeip	pə.gɹei
87.	*help*	help	pel	help	pelh	help	pelh
88.	*helped*	helpt	dəp.hel	helpt	dəp.hel	helpt	dəp.hel
89.	*hobnob*	hop.nop	pno.pho	hop.nop	nop.hop	hop.nop	hop.ho
90.	*implore*	im.plo	ʌ.plo.im	im.ploə	ʌ.plo.im	im.ploʌ	ʌ.plo.im
91.	*improve*	im.pɹuf	f̩.pɹu.im	im.pɹuf	pɹuf.im	im.pɹuf	pɹuf.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	iŋ.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fən.neit	nei.fən.de.in	in.de.fə.neit	neit.fən.de.in	in.de.fə.neit	neit.fən.de.in
95.	*independent*	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dənt.pen.di.in	in.di.pen.dənt	dənt.pen.di.in
96.	*inflict*	in.flikt	flikt.in	in.flekt	flekt.in	in.flekt	flekt.in
97.	*infuse*	in.fius	sfi.in	in.fius	sfiu.in	in.fius	fius.in
98.	*ink*	iŋk	kiŋ	iŋk	kiŋ	iŋk	kiŋ
99.	*inked*	iŋ.kət	dək.iŋ	iŋ.kət	dək.iŋ	iŋkt	dək.iŋ
100.	*inks*	iŋks	skiŋ	iŋks	siŋ	iŋks	siŋ
101.	*instinct*	in.stint	dins.in	ins.diŋt	diŋs.in	ins.diŋt	diŋs.in
102.	*instrument*	ins.tɹu.mənt	məns.tɹu.in	in.stɹə.mən	mən.stɹou.in	in.stɹu.mənt	mən.stɹou.in
103.	*i-Tunes*	ai.tuns	stun.ai	ai.tuns	stun.ai	ai.tuns	stun.ai
104.	*jasmine*	dʒes.mən	məns.dʒe	dʒes.min	mins.dʒe	dʒes.mən	məns.dʒe
105.	*jumps*	dʒʌms	sdʒʌm	dʒʌms	sdʒʌm	dʒʌms	sdʒʌm
106.	*kept*	kept	tepk	kept	tepk	kept	tepk
107.	*lapse*	leps	slep	leps	sle	leps	slep
108.	*lapsed*	lepst	təs.lep	lepst	dəs.le	lepst	dəs.lep
109.	*larks*	laks	sla	laːks	slaːk	laːks	sla
110.	*lend*	lent	den	lent	den	lent	den
111.	*lift*	lift	tif.li	lift	tsf.li	lift	ftli
112.	*lisp*	lisp	spli	lisp	spli	lisp	spli
113.	*lived*	lift	dəf.li	lift	dəf.li	lift	dəf.li
114.	*lives*	lʌifs	sflʌi	lʌifs	sflʌi	lʌifs	sflʌi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	kol	lok	ko	lok	ko
116.	*log*	lok	goː	lok	goː	lo	o
117.	*lump*	lʌmp	pʌm	lʌmp	pʌm	lʌmp	pʌm
118.	*matched*	metʃt	tətʃ.me	metʃt	dətʃ.me	metʃt	dətʃ.me
119.	*melt*	melt	tsme	melt	telm	melt	telm
120.	*milk*	milk	kə.mil	miuk	kium	miuk	kium
121.	*misquote*	mis.kʷout	kʷous.mi	mis.kwout	kwout.mis	mis.kwout	kwout.mis
122.	*ounce*	auns	s̩.aun	auns	saun	auns	s.aun
123.	*owns*	ons	son	ons	son	oŋs	soŋ
124.	*ox*	ɒks	so	oks	so	oks	soː
125.	*participate*	pʌ.ti.sə.peit	ts̩.pei.si.ti.pʌ	pa.ti.sə.peit	peit.sə.ti.pa	pa.ti.sə.peit	pei.sə.ti.pa
126.	*peacemaking*	pis.mei.kiŋ	kiŋ.mek.spi	piːs.mek.kiŋ	kiŋ.mek.spiː	pis.mek.kiŋ	kiŋ.mek.spi
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.sə.dən.si	si.dən.sə.pɹe	pɹe.sə.dən.si	si.dən.sə.pɹe	pɹe.sə.dən.si	si.dən.sə.pɹe
130.	*puffs*	pʌfs	sfpʌ	pʌfs	sf.pʌ	pʌfs	sf.pʌp
131.	*raised*	ɹeist	dəs.ɹʌ	ɹeist	dəs.ɹei	ɹeist	dəs.ɹei
132.	*range*	ɹeintʃ	tʃɹein	ɹeŋtʃ	tʃɹeŋ	ɹeŋtʃ	tʃɹeŋ
133.	*recommend*	ɹe.kə.men	men.kəm.ɹe	ɹe.kəm.men	meŋ.kən.ɹe	ɹe.kʌm.men	meŋ.kʌm.ɹe
134.	*recruiter*	ɹi.kɹu.ta	ta.kɹu.ɹi	ɹi.kɹu.tʌ	tʌ.kɹu.ɹi	ɹi.kɹu.tʌ	tʌ.kɹu.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹi.dʒu.fɹi.ɹi	ɹi.fɹi.dʒu.ei.tʌ	tʌ.ɹi.dʒu.fɹi.ɹi	ɹi.fɹi.dʒu.ɹei.tʌ	tʌ.ɹi.dʒu.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sen.pɹi.ɹe	ɹe.pɹi.sen.tei.tif	tif.tei.sen.pɹi.ɹe

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	dəʃ.ɹʌ	ɹʌʃt	dəʃ.ɹʌ	ɹʌʃt	dəʃ.ɹʌt
139.	*scratch*	skɹetʃ	tʃkɹes	sgɹetʃ	tʃgɹes	sgɹetʃ	tʃgɹes
140.	*scree*	skɹiː	iːɹs	sgɹiː	iːks	sgɹiː	gɹiːs
141.	*segment*	sek.mən	mən.sek	sek.mən	mən.se	sek.mən	mən.se
142.	*senseless*	sens.ləs	sləs.sen	sens.ləs	sləs.sen	sens.ləs	ləs.sens
143.	*sequence*	si.kwəns	skwən.si	si.kwəns	skwən.siː	si.kwəns	skwən.siː
144.	*shameless*	ʃeim.ləs	sleimʃ	ʃeim.ləs	slə.eimʃ	ʃeim.ləs	slə.eimʃ
145.	*shelve*	ʃelf	fʃe	ʃelf	felʃ	ʃelf	felʃ
146.	*shelved*	ʃelft	dəf.ʃel	ʃelft	dəf.ʃel	ʃelft	dəf.ʃel
147.	*skate*	skeit	tə.geis	sgeit	tə.geis	sgeit	geis
148.	*skating*	skei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis
149.	*slope*	slup	pə.los	slop	pə.los	slop	lops
150.	*small*	smoː	moːs	smoː	mos	smoː	moːs
151.	*smooth*	smuθ	θmus	smuf	mufs	smuf	fums
152.	*snatch*	snetʃ	tʃnes	snetʃ	tʃnes	snetʃ	tʃnes
153.	*spa*	spaː	aps	sbaː	baːs	sbaː	baːs
154.	*spare*	speʌ	ʌ.bes	sbeʌ	ʌ.bes	sbeʌ	ʌ.bes
155.	*sphere*	sfiʌ	ʌ.fis	sfɪʌ	ʌ.fis	sfiʌ	ʌ.fis
156.	*spiritual*	spi.ɹi.tʃəl	tʃəl.ɹi.bis	sbi.ɹi.tʃəl	tʃəl.ɹi.sbi	sbi.ɹi.tʃəl	tʃəl.ɹi.bis
157.	*splendid*	splen.dət	dət.blens	sblen.də	də.blens	sblen.dət	dət.blens
158.	*split*	split	lisp	sblit	lisp	sblit	blis
159.	*spoil*	spoil	əl.bois	sboil	əu.bois	sboil	əu.bois
160.	*spray*	spɹei	ɹeisp	sbɹei	ɹeisp	sbɹei	ɹeisp

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹiŋ	ɹiŋps	spɹiŋ	ɹinsp	spɹiŋ	ɹiŋsp
162.	*springs*	spɹiŋs	sɹiŋsp	sbɹiŋs	sɹiŋsp	sbɹiŋs	ɹiŋsp
163.	*squeeze*	skwiːs	skwiːs	sgwiːs	sgwiːs	sgwiːs	sgwiːs
164.	*stain*	sten	enst	sden	dens	sten	enst
165.	*star*	staː	ɹʌs	sdaː	aːst	sdaː	aːst
166.	*string*	stɹiŋ	ɹiŋst	sdɹiŋ	ɹiŋst	sdɹiŋ	ɹiŋst
167.	*stupid*	stju.pə	pə.djus	sdiu.bə	bə.djus	sdiu.bə	bə.dius
168.	*suppose*	sə.pous	spou.sə	sʌp.pous	pous.sʌp	səp.pous	spou.sət
169.	*swim*	swim	wims	swim	mwis	swim	wims
170.	*text*	tekst	tekst	tekst	tekst	tekst	tekst
171.	*thankful*	θeŋk.fəl	fəlk.θen	θeŋk.fəu	fəu.θeŋk	θeŋk.fəu	fəu.θeŋk
172.	*trenched*	tɹentʃt	dətʃ.tʃe	tɹentʃt	detʃ.tʃən	tɹentʃt	dətʃ.tɹen
173.	*tweet*	twit	twit	twit	tswits	twit	twit
174.	*underpaid*	ʌn.də.peit	də.pei.də.ʌn	ʌn.də.peit	pei.də.ʌn	ʌn.də.pei	pei.dʌ.ʌn
175.	*understand*	ʌn.də.sten	dens.də.ʌn	ʌn.də.sdæn	dæn.sdə.ʌn	ʌn.də.sdæn	dæn.sdʌ.ʌn
176.	*urge*	əɹtʃ	tʃ.əɹ	ətʃ	tʃə	əːɹtʃ	tʃ.əːɹ
177.	*Welsh*	welʃ	ʃwel	welʃ	ʃwel	welʃ	ʃwel
178.	*whereabout*	weə.ʌ.bʌut	bʌut.ʌ.e.we	weə.ʌ.bʌut	bʌut.ʌ.ə.we	weə.ʌ.bʌut	bʌut.ʌ.ə.we
179.	*wolf*	wuf	fu	wuːf	fuː	wuːf	fuː
180.	*woodland*	wut.lent	lent.wu	wud.len	lent.wuː	wut.len	lent.wut

III. HK-M-23-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹeit	fɹei.də	ʌ.fɹeid	fɹeid.ʌ	ʌ.fɹeid	fɹeid.ʌ
2.	*age*	eitʃ	tʃ.ei	eitʃ	tʃ.ei	eitʃ	tʃ.ei
3.	*Alps*	elps	selp	elps	s.elp	elps	s.elp
4.	*amuse*	ʌ.mius	mius.ə	ʌ.mius	ɕmiu.ʌː	ə.mius	mius.ə
5.	*anguish*	en.gwiʃ	ʃgwi.en	en.gwiʃ	gwiʃ.en	en.gwiʃ	gwiʃ.en
6.	*anklet*	enk.net	nek.enk	en.klet	klet.en	enk.net	let.enk
7.	*ant*	ænt	tæn	ent	tɕen	entɕ	tɕ.en
8.	*approve*	ʌ.pɹuf	pɹuf.ə	ʌ.puf	puf.ʌ	ʌ.puf	puf.ʌ
9.	*ask*	aːsk	ki.as	ask	kə.as	ask	k.as
10.	*asked*	aːst	də.as	aːsd	d.ask	aːskt	d.ask
11.	*asks*	aːsks	ki.sas	as	ɕi.a	ask	s.aks
12.	*bangs*	bæŋs	sbæŋ	bæns	sbæn	bæns	sbæn
13.	*begged*	be.də	də.be	bed	dbe	bed	dbe
14.	*begs*	beks	sbek	beks	sbek	beks	sbek
15.	*blast*	blaːst	stblaː	blaːst	stblaː	blaːst	stblaː
16.	*bled*	bled	dep	blet	də.bleː	bled	dble
17.	*bloom*	buːn	muːn	bluŋ	lumb	blun	lump
18.	*blunt*	blʌnt	tɕi.lʌm.bə	blʌnt	tɕblʌn	blʌnt	tɕblʌn
19.	*blur*	bəːɹ	əp	blə	ləb	bəː	ləːp
20.	*brief*	bɹif	fɹi.bɹi	bɹif	fbɹi	bɹif	fbɹiː
21.	*Britain*	bɹi.tən	təm.bɹit	bɹə.tən	tən.bɹi	bɹə.tən	tən.bɹi
22.	*bronze*	bons	ɕi.bon	boːns	sboːn	bɹons	sbon

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	diub	biud	dbiu	biud	dbiu
24.	*bulb*	bʌp	ʌ.bə	bʌp	bʌp	bʌp	bʌp
25.	*bulbs*	bʌps	sbʌp	bʌps	sbʌp	bʌps	sbʌp
26.	*cashback*	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ
27.	*clarify*	kæ.ɹə.fai	fai.ɹə.kæ	kæ.ɹə.fai	fai.ɹe.ke	kæl.ɹə.fai	fai.ɹə.ke
28.	*Clark*	kɹæk	kɹ.kwæ	kɹak	kə.kɹæ	kɹæk	kkɹæ
29.	*clear*	kliə	ə.ki	kɹiə	ʌ.ki	kɹiə	ə.kli
30.	*cliff*	klif	lifk	klif	lifk	klif	nifk
31.	*close*	kous	skou	kous	skou	kous	skou
32.	*closure*	kou.ʃə	ʃə.kou	kou.ʃə	ʃə.kou	kou.ʃə	ʃə.kou
33.	*clothing*	kou.θiŋ	θiŋ.kou	kou.θiŋ	θiŋ.kou	kou.θiŋ	θiŋ.kou
34.	*clubbed*	kʌp.də	də.kʌp	kʌpt	tkʌp	kʌpd	dkʌp
35.	*Constantine*	kon.stən.tin	tin.stən.kon	koŋ.stən.tin	tin.stən.kon	koŋ.stən.ti	tin.stən.kon
36.	*corpse*	kops	skop	kops	skop	kops	skop
37.	*crawl*	kwau	wauk	koː	woːk	koː	woːk
38.	*crisp*	kɹips	sɹuk	kɹisp	ɹisk	kɹips	spkɹip
39.	*crow*	kwou	wouk	kwou	wouk	kou	wouk
40.	*crown*	kwan	waŋk	kwan	waŋk	kɹaun	n.kɹau
41.	*cry*	kwai	waik	kwai	waik	kwai	waik
42.	*cube*	kup^h	upk	kup	b.ku	kub	bku
43.	*digest*	dʌi.dʒest	dʒes.dʌi	dʌi.dʒest	dʒes.dʌi	dʌi.dʒest	dʒest.dʌi
44.	*disband*	dis.bent^h	ben.dis	dis.bent^h	ben.dis	dis.bend	ben.dis
45.	*disclaim*	dis.kain	kain.dis	dis.kem	klen.dis	dis.kɹen	klen.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.kʌs	kʌs.dis	dis.kʌs	kʌs.dis	dis.kʌs	kʌs.dis
47.	*dumped*	dʌmt	tə.dʌm	dʌmt	tdʌm	dʌmt	ddʌm
48.	*east*	iːst	st.iː	iːst	t.iːs	iːst	t.iːs
49.	*eats*	is	çi.iː	is	s.i	its	s.it
50.	*Ed*	ed	de	ed	de	ed	d.e
51.	*edge*	etʃ	tʃi.e	etʃ	tʃ.e	etʃ	tʃ.e
52.	*elf*	elf	fv.el	elf	fv.el	elf	f.el
53.	*else*	els	ç.el	els	ç.el	els	s.el
54.	*elves*	els	fs.el	elfs	fs.el	elfs	fs.el
55.	*encourage*	en.kə.ɹeitʃ	tʃɹei.kə.ən	en.kə.ɹeitʃ	ɹeitʃ.kə.ən	en.kə.ɹeitʃ	weitʃ.kə.ən
56.	*encouraging*	eŋ.kə.ɹei.dʒiŋ	dʒiŋ.ɹei.kə.en	eŋ.kə.ɹei.dʒiŋ	dʒiŋ.ɹei.kə.en	eŋ.kəːɹei.dʒiŋ	dʒiŋ.ɹei.kə.en
57.	*English*	iŋ.gəʃ	ləʃ.gə.iŋ	iŋ.gliʃ	gliʃ.iŋ	iŋ.gəʃ	gəʃ.iŋ
58.	*ex-con*	es.kon	kon.es	es.kon	kon.es	es.kon	kon.es
59.	*excuse*	es.kius	çi.kiu.es	eis.kius	skiu.es	es.kius	kius.es
60.	*exhale*	es.hel	hel.es	es.hel	hel.es	es.hel	hel.es
61.	*explode*	es.bod	bod.es	es.boud	boud.es	es.boud	bou.es
62.	*fabric*	fɹai.bɹik	bɹə.fai	fæ.bɹik	bɹik.fæ	fai.bɹik	bɹik.fai
63.	*fact*	fæt	tçi.fæ	fæt	tfæ	fæt	tçfæ
64.	*famed*	fem.tə	tə.fem	feimd	dfem	feimt	tfeim
65.	*fed*	fit	dif	fid	dfi	fet	def
66.	*film*	fɹim	minf	fim	minf	fim	minf
67.	*fish*	fiʃ	ʃfi	fiʃ	ʃfi	fiʃ	ʃfi
68.	*flap*	flæp	pæf	flæp	læpf	flæp	læpf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flət	təf	fət	tfəː	fət	tfə
70.	*flu*	fuː	luːf	fuː	uːf	flu	luf
71.	*fly*	fai	aif	fai	aif	fai	aif
72.	*foolish*	fu.liʃ	ʃi.li.fuː	fu.liʃ	liʃ.fuː	fu.liʃ	liʃ.fu
73.	*frank*	fɹenk	kfɹen	fɹeŋk	kfɹen	fɹeŋk	kfɹen
74.	*Franks*	fenks	kəs.fen	fɹenks	sfenk	fɹenks	ksfɹen
75.	*free*	fɹiː	ɹiːf	fɹi	ɹif	fɹi	ɹiːf
76.	*freshness*	feʃ.nis	nəs.feʃ	feʃ.nəs	nəs.feʃ	feʃ.nəs	nəs.feʃ
77.	*friend*	fɹent	ɹenf	fɹend	ɹentf	fɹent	dfɹen
78.	*fringe*	fɹintʃ	tʃfɹin	fɹintʃ	tʃfɹin	fɹintʃ	tʃfɹin
79.	*games*	gems	sgem	gems	sgem	gems	sgem
80.	*gasped*	gaspt	tpgas	gespt	ptges	gaspd	ptgas
81.	*gasps*	geps	pis.ges	gesps	sgeps	gasps	psgas
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	gluː	luː	gluː	luːk	gluː	luːk
84.	*grab*	gɹæp^h	baː	gɹæp	bə.gɹæ	gɹæp^h	pə.dʒæ
85.	*grant*	gwænt	tçwænk	gwʌnt	tgwʌn	gɹent	tgɹen
86.	*grape*	gɹæp	pɹæk	gɹæp	pə.gɹæp	gweip	pgwei
87.	*help*	help	pə.hel	help	pə.hel	help	pə.hel
88.	*helped*	helpt	thelp	helpt	thel	helpt	thelp
89.	*hobnob*	hop.lop^h	lop.hop	hop.lop	lop.hop	hop.lup	lup.hup
90.	*implore*	in.po.ə	ʌ.po.in	im.pɹoː	pɹoː.in	im.poi.ə	ʌ.poi.in
91.	*improve*	im.puf	puf.in	im.puf	puf.in	im.puf	puf.in

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃ.in
93.	*increasing*	in.kwi.siŋ	siŋ.kwi.in	in.kwi.siŋ	siŋ.kwi.in	in.kwi.siŋ	siŋ.kwi.in
94.	*indefinite*	in.de.fən.nət	nət.fən.de.in	in.de.fə.nət	nə.fən.de.in	in.de.fə.nət	nət.fən.de.in
95.	*independent*	in.di.pen.dən	dənt.pen.di.in	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dənt.pen.di.in
96.	*inflict*	in.fə.lit	lət.fə.in	in.flekt	flekt.in	in.flet	flət.in
97.	*infuse*	in.fius	s.fiu.in	in.fius	fius.in	in.fius	fius.in
98.	*ink*	ink	kin	ink	kin	ink	kin
99.	*inked*	inkt	kə.din	iŋkt	t.iŋk	inkt	kt.in
100.	*inks*	iŋks	skin	ins	sin	iŋks	s.iŋk
101.	*instinct*	in.sdiŋt	tsdiŋ.in	in.sdiŋt	sdiŋt.in	in.sdiŋt	sdiŋt.in
102.	*instrument*	in.sʃu.mən	mən.sʃu.in	in.ʃu.mən	mən.ʃu.in	in.sʃu.mən	mən.sʃu.in
103.	*i-Tunes*	ʌi.tuns	stun.ʌi	ʌi.tuns	tuns.ʌi	ʌi.tuns	tuns.ʌi
104.	*jasmine*	dʒʌs.min	min.sdʒʌ	dʒʌs.min	min.dʒʌs	dʒʌs.min	min.dʒʌs
105.	*jumps*	dʒʌms	ɕi.ʌm.dzɨ	dʒʌms	sdʒʌm	dʒʌms	sdʒʌm
106.	*kept*	kipt	tkip	kept	tkep	kept	tɕkep
107.	*lapse*	læps	ɕi.læp	læps	slæp	læps	slæp
108.	*lapsed*	læps.də	dəs.læp	læpsd	sdlæp	læpst	stlæp
109.	*larks*	laks	kəs.la	laks	slak	laks	ksnaː
110.	*lend*	nent	de.nə	lent	dlen	nent	tnen
111.	*lift*	nift	ftni	nift	ftniː	nift	tsnif
112.	*lisp*	lips	pis.nip	lisp	plis	nisp	spli
113.	*lived*	lift	fv.li	nift	də.fu.ni	nift	tnif
114.	*lives*	laifs	sflai	laifs	slaif	laifs	sflai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	ko	lok	klo	lok	k.lo
116.	*log*	lok	gol	lok^h	klo	lok^h	klo
117.	*lump*	lʌmp	plʌn	nʌmp	plʌm	nʌmp	pnʌm
118.	*matched*	mætʃt	dətʃ.mæ	mætʃt	dtʃmæ	mætʃt	ttʃmæ
119.	*melt*	melt	tɕmel	melt	tɕmel	melt	tɕmel
120.	*milk*	miuk	kə.miu	miuk	kmiu	miuk	kmiu
121.	*misquote*	mis.kout	kout.mis	mis.kout	kout.mis	mis.kout	kout.mis
122.	*ounce*	ous	saun	oŋs	s.on	ons	ɕ.on
123.	*owns*	oŋs	s.oŋ	oŋs	soŋ	oŋs	s.oŋ
124.	*ox*	os	soː	os	s.o	os	s.o
125.	*participate*	pa.ti.sə.peit	pei.sə.ti.pə	pə.ti.sə.peit	peit.sə.ti.pə	pə.ti.sə.pei	pei.sət.ti.pə
126.	*peacemaking*	piːs.mek.kiŋ	kiŋ.mek.ɕi.piː	piːs.mek.kiŋ	kiŋ.mek.piːs	piːs.mek.kiŋ	kiŋ.mek.piːs
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	weip	pɹei	weip
129.	*presidency*	pe.si.dən.si	ɕiː.dən.səs.pe	pɹe.si.dən.si	ɕi.dən.sə.pɹe	pɹe.sə.dən.si	ɕi.dən.səs.pɹe
130.	*puffs*	pʌfs	fspʌf	pʌfs	spʌf	pʌfs	spʌf
131.	*raised*	weist	sdwei	weis.də	də.ɹeis	weist	st.wei
132.	*range*	weŋtʃ	tʃy.weŋ	weŋtʃ	tʃweŋ	weŋtʃ	tʃweŋ
133.	*recommend*	ɹe.kə.ment	men.ken.ɹe	ɹe.kə.ment	men.ken.we	we.kə.ment	men.ken.we
134.	*recruiter*	ɹi.ku.tə	tʌ.ku.ɹiː	ɹi.ku.tʌ	tʌ.ku.ɹi	ɹi.ku.tʌ	tʌ.ku.ɹi
135.	*refrigerator*	ɹi.fe.dʒu.ɹei.tə	tʌ.ɹei.dʒo.fe.ɹi	ɹi.fe.dʒu.ɹei.tə	tʌ.ɹei.fe.dʒə.ɹi	ɹi.fe.dʒu.ɹei.tə	tʌ.wei.dʒə.fe.wi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.nei.wiː	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹiː	ɹi.lei.ʃən.ʃip	ʃip.ʃən.nei.wi
137.	*representative*	ɹe.pi.sen.tə.tif	tif.tə.sem.pi.ɹet	ɹe.pə.sen.tə.tif	tif.tə.sem.pə.ɹe	ɹe.pɹə.sen.tə.tif	tif.tə.sem.pi.we

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	wʌʃt	dʌʃ.wʌt	wʌʃt	dʃwʌt	wʌʃt	dʃwʌt
139.	*scratch*	sgwætʃ	tʃy.gwæ.ɕi	sgwætʃ	tʃgwæs	sgwætʃ	tʃsgwæ
140.	*scree*	sgwiː	gwiːs	skwiː	kwiːs	skwiː	kwiːs
141.	*segment*	sek.mənt	mən.sek	se.mən	mən.sek	sek.mən	mən.sek
142.	*senseless*	sens.nəs	nəs.sens	sens.nəs	nəs.sens	sens.nəs	nəs.sens
143.	*sequence*	ɕi.kwəns	skwən.ɕiː	ɕi.kwəns	skwən.ɕiː	ɕi.kwən.ɕi	ɕi.kwən.ɕiː
144.	*shameless*	ʃen.nes	nes.ʃein	ʃem.nəs	nʌs.ʃem	ʃeim.nəs	nəs.ʃeim
145.	*shelve*	ʃelf	fv.elʃ	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelft	dfʃel	ʃelft	dʃelf	ʃelft	ftʃel
147.	*skate*	sgeit	tssgei	sgeit	geits	sgeit	tsgei
148.	*skating*	sgei.tiŋ	tiŋ.gei.ɕi	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.geis
149.	*slope*	slop	lops	slop	lops	snaup	laups
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuθ	θə.mus	smuθ	muθs	smuθ	muθs
152.	*snatch*	snetʃ	tʃi.nes	snetʃ	tʃnes	snetʃ	tʃnes
153.	*spa*	sbaː	baːs	sbaː	baːs	sbaː	baːs
154.	*spare*	speʌ	ʌ.bes	speʌ	beəs	sbeə	beəs
155.	*sphere*	sfi.ʌ	ʌ.fi.ɕi	sfi.ə	ʌ.fi.ɕi	sfiə	fiəs
156.	*spiritual*	sbə.ɹi.tʃou	tʃou.ɹə.bɹi.ɕi	sbi.ɹi.tʃou	tʃou.ɹi.sbi	sbi.ɹi.tʃou	tʃou.wi.bi.ɕi
157.	*splendid*	sben.dit	di.sben	sblen.də	də.sblen	sblen.di	di.sblen
158.	*split*	sbit	biɕ	sbɹit	blis	sblit	blits
159.	*spoil*	sbo.jou	ou.boi.ɕiː	spo.jou	po.jous	sbo.jou	bo.jous
160.	*spray*	sbɹei	bɹeis	sbɹei	bɹeis	sbɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbwiŋ	bwiŋs	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs
162.	*springs*	sbwiŋs	sbiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs
163.	*squeeze*	sgwiːs	çi.sgwis	sgwiːz	zzkwiːs	sgwiːz	zzkwiːs
164.	*stain*	sdeŋ	deŋs	sdeŋ	deŋs	sdeŋ	deŋs
165.	*star*	sdaː	daːs	sdaː	daas	sdaː	daːs
166.	*string*	sdʒwiŋ	dʒwiŋs	sɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs
167.	*stupid*	sdiu.bət	bə.dius	sdiu.bət	bət.sdiu	sdiu.bət	bət.sdiu
168.	*suppose*	səp.pous	pou.sə	səp.pous	pou.səp	səp.pous	pou.sə
169.	*swim*	swiŋ	wiŋs	swiŋ	wiŋs	swim	wims
170.	*text*	teːs	steː	test	stte	test	stte
171.	*thankful*	θenk.fəl	fəl.θenk	θenk.fəl	fəl.θenk	θenk.fəl	fəl.θenk
172.	*trenched*	tʃentʃt	dtʃtʃen	tʃentʃd	dtʃtʃen	tɹentʃt	dtʃtʃen
173.	*tweet*	twit	i.tə	twit	tçi.twi	twit	tç.twi
174.	*underpaid*	ʌn.də.pei	pei.də.ʌn	ʌn.də.peid	pei.də.ʌn	ʌn.də.peit	pei.də.ʌn
175.	*understand*	ʌn.də.sden	den.sdə.ʌn	ʌn.də.sden	sden.də.ʌn	ʌn.də.sden	sden.dʌ.ʌn
176.	*urge*	əːtʃ	tʃi.əː	əːtʃ	tʃ.əː	əːtʃ	tʃ.əː
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃ.wel	welʃ	ʃ.wel
178.	*whereabout*	weə.ʌ.bʌut	bʌu.ʌ.ʌ.we	weə.ʌ.bout	ʌ.bout.weə	weə.ʌ.bout	ʌ.bout.weə
179.	*wolf*	woːf	f.woː	wuːf	fuː	woːf	f.woː
180.	*woodland*	wut.len	len.hut	wut.len	len.wut	wu.nen	nen.wut

IV. HK-M-31-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	af.fɹeid	fɹei.aːf	ʌ.fɹeid	də.fɹei.aː	ʌ.fɹeit	fɹeid.aː
2.	*age*	eidʒ	dʒə.ei	eidʒ	dʒʌ.ei	eidʒ	dʒʌ.ei
3.	*Alps*	e.aːps	sə.æp	eaps	sə.ep	eu.ps	sə.eup
4.	*amuse*	ʌm.mjuːs	sɨ.mjuː.aː	ʌm.mjuːs	səm.mjuː.aː	ʌm.mjuːs	su.mjuː.aː
5.	*anguish*	eŋ.gliʃ	glɨʃ.en	æŋ.gəʃ	gəs.en	æŋ.gliʃ	gləs.en
6.	*anklet*	æŋ.klet	klʌt.en	æŋk.lat	lʌt.eŋk	æŋ.klʌt	klʌt.en
7.	*ant*	ent	tə.en	ent	tə.en	ent	tə.en
8.	*approve*	e.pɹuːf	pɹuf.æːp	a.pɹuːf	fu.pɹu.ap	æ.pɹuːf	fɹu.pɹuf.æp
9.	*ask*	ɒːsk	kə.aːs	ɒːsk	kə.aːs	ɒːsk	kə.aːs
10.	*asked*	ɒːs.ted	dʌt.aːsk	ɒːs.ted	dʌt.aːs	ɒːs.ted	dʌt.aːsk
11.	*asks*	ɒs	sɨ.ɒk	aːɹts	sə.aːs	ɒːsk	sə.aːsk
12.	*bangs*	bænts	sə.bæŋ	bænts	sə.bæŋ	bænts	sə.bæŋ
13.	*begged*	bæt.ted	gʌkt.pæk	bæk.ted	dʌtk.bæk	bæk.ted	dʌk.bæk
14.	*begs*	bæ.ges	gʌs.bæ	bæ.ks	sə.bæːk	bæ.gʌs	sə.bæːk
15.	*blast*	blaːst	sɨ.bɭaː	blaːst	tə.blaːs	blaːst	te.blaːs
16.	*bled*	blæt	dɨ.bɭæ	bləːd	dʌ.bleː	blæd	dʌ.bleː
17.	*bloom*	bluːm	m.bluː	bluːm	m.blə	bluːm	m.blə
18.	*blunt*	blʌnt	tsɨ.bɭʌn	blʌnt	te.blʌn	blʌnt	te.blʌn
19.	*blur*	bləː	əːb	bləː	əːbləː	bləː	əː.bləː
20.	*brief*	bɹiːf	fəɹ.bɹiː	bɹiːf	fəɹ.bɹiː	bɹiːf	fəɹ.bɹiː
21.	*Britain*	bɹet.tɨn	tən.bɹit	bɹi.tin	tən.bɹit	bɹeː.tən	ten.bɹit
22.	*bronze*	bɹɒnz	si.bɹɒn	bɹɒnz	zi.bɹɒn	bɹɒnz	zi.bɹɒːn

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biwt	tə.biw	biud	də.biw	biud	də.biw
24.	*bulb*	bəːp	bʌ.bʌp	bawp	bʌ.baub	bʌup	bʌ.bʌup
25.	*bulbs*	bɒp.s	sə.bɒp	bɒp.s	sə.bɒp	bɒp.s	si.baːp
26.	*cashback*	kæʃ.bæk	bæk.kæʃ	keʃ.bæk	bæk.kæʃ	keʃ.bak	bæk.keʃ
27.	*clarify*	keː.ɹi.fai	fai.ɹə.kaː	keː.ɹə.fai	fai.ɹə.keə	keː.ɹi.fai	fai.ɹə.keə
28.	*Clark*	klaːk	kə.klaː	klaːk	kə.klaː	klaːk	kʌ.klaː
29.	*clear*	kliə	ə.kliː	kliː.əː	ʌ.kliː	kliː.əː	ʌ.kliː
30.	*cliff*	klif	fu.kliː	klif	fə.kli	kliːf	fə.kliː
31.	*close*	klous	si.klou	klous	si.klʌu	klous	si.klou
32.	*closure*	klou.səɹ	sə.klou	klou.seɹ	se.klʌu	klou.səɹ	səː.klou
33.	*clothing*	klou.θiŋ	fliŋ.kou	klou.θiŋ	θiŋ.klʌu	klou.θeŋ	fleŋ.klou
34.	*clubbed*	klʌb.det	de.klɒp	klʌb.det	dʌt.klɒp	klu.bəːd	bet.klaːp
35.	*Constantine*	kɒn.stʌn.tin	tiːn.stiŋ.kɒːn	kɒn.stən.tain	tai.steŋ.kɒːm	kɒn.stən.tain	tai.steŋ.kɒːn
36.	*corpse*	kɹops	sɨp.kɹɒ	kɹop.s	si.kɹop	kɹop.s	si.kɹoːp
37.	*crawl*	kɹʌu	lo.kɹɒː	kɹʌu	ou.kɹaː	kɹɒː	oː.kɹaː
38.	*crisp*	kɹipsp	sp.kɹiː	kɹips	si.kɹiː	kɹips	si.kɹiː
39.	*crow*	kɹau	ɹauk	kɹau	ʌu.kɹaː	kɹau	ʌu.kɹaː
40.	*crown*	kɹɒn	ɹɒŋk	kɹawŋ	ŋ.kɹaw	kɹawm	wen.kɹaum
41.	*cry*	kɹai	ai.kɹaː	kɹai	ai.kɹa	kɹaːj	ai.kɹaː
42.	*cube*	kjuːp	bʌ.ky	kjuːp	bə.kyː	kjuːp	be.kuː
43.	*digest*	dʌi.ʤest	ʤest.dai	dai.dʒest	dʒest.dai	dai.dʒest	dʒest.dai
44.	*disband*	dis.bæn	bæn.dis	dis.bæn	bæn.dis	dis.bænd	bæn.dis
45.	*disclaim*	dis.kɭeim	kɭeim.dis	dis.kleim	kleim.dis	dis.kleim	kleim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.kʌs	kʌs.dis	dis.gʌs	gʌs.dis	dis.kʌs	kʌs.dis
47.	*dumped*	dɒmp.ted	dɨt.dam	dʌmp.ted	det.dʌmp	dʌmp.tet	det.dʌmp
48.	*east*	iːst	tʌd.iːs	iːst	tʌ.iːs	iːst	tʃʌ.iːs
49.	*eats*	jiːts	sə.iːt	iːts	sə.iːt	iːts	sə.iːt
50.	*Ed*	æːd	də.aː	æːt	də.eə	æːt	də.æː
51.	*edge*	eːdʒ	dʒo.eə	eːdʒ	dʒo.æd	eːdʒ	dʒo.eə
52.	*elf*	euf	fu.eu	euf	fu.eu	euf	fu.eu
53.	*else*	eus	sə.eu	eus	sə.eu	eus	sə.eu
54.	*elves*	ew.vɨs	sɨ.fo.ew	eu.fs	vus.eu	euv.s	vəs.eu
55.	*encourage*	eːŋ.kəː.ɹeidʒ	ɹeidʒ.kəɹ.eːn	eŋ.kəː.ɹeidʒ	dʒə.ɹei.kəɹ.eːn	eŋ.kəː.ɹeːdʒ	edʒ.kəɹ.eːn
56.	*encouraging*	eŋ.kəː.ɹei.dʒiŋ	dʒun.ɹei.kəɹ.eːn	eŋ.kəː.ɹei.dʒiŋ	dʒiŋ.ɹei.kəɹ.eːn	eŋ.kəː.ɹei.dʒiŋ	dʒin.ei.kəɹ.eːn
57.	*English*	eŋ.gleʃ	ʃit.glʌ.ʔeŋ	iŋ.gliʃ	gliʃ.eŋ	eŋ.gleʃ	gluʒ.en
58.	*ex-con*	eks.kɒn	kɒn.eks	eks.kɒn	kɒn.eks	eks.kɒn	kɒn.eks
59.	*excuse*	eks.kjuːs	kjuːs.eks	eks.kjuːs	sə.kjuː.eks	eks.kjuːs	kjuːs.eks
60.	*exhale*	eks.heː.o	heːw.eks	eks.heː.o	heːw.eks	eks.heː.o	heːw.eks
61.	*explode*	eks.ploud	dɨ.ploː.eks	eks.ploud	bloud.eks	eks.ploud	plou.eks
62.	*fabric*	fɹaː.bɹek	bɹek.faː	faː.bɹek	bɹek.faː	faː.bɹek	bɹek.faː
63.	*fact*	fæt	tu.fæ	fæt	tə.fæ	fæt	tə.fa
64.	*famed*	feim.det	dʌt.feim	feim.det	dʌt.feim	feim.det	dʌɹ.feim
65.	*fed*	fæd	dɨ.fæ	fæd	dʌ.fe	fæd	dʌ.fea
66.	*film*	fim	minf	fim	m.fi	flim	m.fleu
67.	*fish*	fiʃ	ʃəː.fiː	fiʃ	ʃə.fi	fiʃ	ʃəː.fiː
68.	*flap*	flap	pəɹ.flæ	flæp	plə.flaː	flæp	pə.flaː

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	fəːt	tuf.ɭəː	fləːt	tʃʌ.fləː	fləːt	tʃʌ.fləː
70.	*flu*	fɭuː	luːf	fluː	juː.fɹu	fluː	luː.fu
71.	*fly*	fɭai	aifl	flai	ai.flə	flai	ai.flə
72.	*foolish*	fuː.liʃ	lʌʃ.fuː	fuː.leʃ	lʌʃ.fuː	fuː.liʃ	lʌʃ.fuː
73.	*frank*	fɹæŋk	kə.fɹen	fɹæŋk	kʌ.fɹæn	fɹæŋk	kə.fɹæn
74.	*Franks*	fɹæŋ.k(ɨ)s	kəs.fɹæŋ	fɹæŋ.ks	sə.fɹeŋk	fɹæŋ.ks	sə.fɹæŋk
75.	*free*	fɹei	jiːf	fu.ɹei	iː.vɹə	fɹei	iː.fɹə
76.	*freshness*	fɹʌʃ.nes	nʌ.ʃi.fɹæ	fɹæʃ.nes	ne.ʃu.fɹæ	fɹæʃ.nʌs	nəs.fɹæʃ
77.	*friend*	fɹænd	dɨ.fɹaːn	fɹend	æn.də.fɹa	fɹænd	æn.fɹa
78.	*fringe*	fɹinʤ	ʤu.fɹen	fɹindʒ	dʒə.fɹin	fɹindʒ	dʒə.fɹin
79.	*games*	geims	sə.geim	geims	sə.geim	geims	sə.geim
80.	*gasped*	gɹaːps.ted	tʌds.gɹaːp	gɹaːps.ted	deds.gɹaːp	gjæp.stet	det.gæps
81.	*gasps*	gjæps	su.gæp	gjaps	su.geaps	gjeps	su.gæps
82.	*gave*	geif	fu.gei	geif	fu.gei	geif	fu.gei
83.	*glue*	gluː	ju.gluː	gluː	juː.glə	gluː	luː.gə
84.	*grab*	gɹæp	bu.gɹaː	gɹæb	bʌ.gɹaː	gɹæb	bʌ.gɹaː
85.	*grant*	gɹaːnt	tu.gɹaːn	gɹaːnt	tʃə.gɹaːn	gɹaːnt	tʃu.gɹaːn
86.	*grape*	gɹeip	pə.gɹei	gɹeip	pəː.gɹei	gɹeip	pəː.gɹei
87.	*help*	heup	pə.heu	heup	pə.heu	heup	pə.heu
88.	*helped*	haupt	tə.heup	heup.ted	det.heup	haup.ted	det.heup
89.	*hobnob*	hɒp.nɒp	nɒp.hɒp	hɒp.nɒp	nɒp.hɒp	hɒp.nɒp	nɒp.hɒp
90.	*implore*	jim.pɭoː	pɭoː.im	jim.pɹoː	pɹɾ.jim	jim.ploː	ploː.jem
91.	*improve*	im.pɹuːf	fuɹ.pɹu.im	im.pɹuːf	pɹuːf.im	im.pɹuːf	pɹuːv.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	jintʃ	tʃə.in	jintʃ	tʃə.in	intʃ	tʃə.in
93.	*increasing*	iŋ.kɹiː.zeŋ	siŋ.kɹeː.iːn	iŋ.kɹiː.seŋ	siŋ.kɹeː.iːn	iŋ.kɹiː.zeːŋ	siŋ.kɹiː.iːn
94.	*indefinite*	in.daː.fi.nət	te.ne.fə.de.in	in.daː.fi.nət	nət.fiː.dʌ.in	in.daː.fi.nət	nət.fi.di.eːn
95.	*independent*	in.di.pæn.dənt	tʃə.dəm.pæn.diː.in	in.di.pæn.dənt	dənt.pæn.diː.iːn	in.di.pæn.dənt	dən.pæ.diː.in
96.	*inflict*	in.flet	tu.flʌt.in	in.flet	flet.in	in.flet	flet.in
97.	*infuse*	in.vjuːs	sɨ.fjuː.in	in.fjuːs	sə.fəː.jin	in.fjous	fjuːs.in
98.	*ink*	iŋk	kiŋ	iŋk	kə.iŋ	iŋk	kə.iŋ
99.	*inked*	iŋk.ted	tʌk.iŋ	eŋk.ted	dʌk.eŋk	eŋk.ted	dʌk.eːŋk
100.	*inks*	iŋks	sə.iŋ	eŋ.gs	sək.iŋ	eŋk.s	sə.iŋk
101.	*instinct*	in.stent	stʌnt.in	in.stiŋt	steŋt.in	in.stiŋt	stent.in
102.	*instrument*	iːn.stɹu.ment	tə.men.stɹʌ.in	iːn.stɹu.ment	mən.stɹʌt.iːn	iːn.stɹu.mənt	mən.stɹʌ.iːn
103.	*i-Tunes*	ai.tyns	suː.tun.ai	ai.tuns	sə.tun.ai	ai.tuns	tuns.ai
104.	*jasmine*	dʒæs.min	min.dʒæs	dʒæ.sə.min	min.sə.dʒaː	dʒæs.min	min.dʒæs
105.	*jumps*	dʒɒmps	sɨ.jɒm	dʒɒm.ps	si.dʒɒm	dʒɒmp.s	si.dʒɒmp
106.	*kept*	kept	tsə.kep	kapt	tə.kap	kæpt	tʃu.kæp
107.	*lapse*	læps	si.læp	laːps	sə.lap	læps	sʌ.laːp
108.	*lapsed*	læps.tət	dɨs.læp	læps.tet	dʌt.læps	læps.tet	dʌt.læps
109.	*larks*	laː.ks	sə.laːk	laː.ks	sə.laːk	laː.ks	sə.laːk
110.	*lend*	lend	də.len	lend	dʌ.lenn	lænd	də.læn
111.	*lift*	left	tə.lif	lift	tə.lif	leːft	tʌ.lif
112.	*lisp*	liːsp	pə.liːsp	lisp	pə.lis	lisp	pə.lis
113.	*lived*	lift	də.lif	lif.ted	dʌt.liːf	lif.ted	dʌt.liːf
114.	*lives*	laifs	sɨ.fə.lai	laif.s	sə.laif	laif.s	sə.laif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lɒk	kʌ.lɒ	lɒk	kə.lɒ	lɒk	kə.lɒ
116.	*log*	lɒk	gɨ.lo	luːk	gʌ.loː	lɒk	gʌ.lou
117.	*lump*	lʌmp	pəː.lʌm	lʌmp	pəː.lʌm	lʌmp	pe.lʌm
118.	*matched*	mewt	tsɨ.mew	meut	tə.meu	meut	tsə.mæu
119.	*melt*	mewt	tsɨ.mew	meut	tə.meu	meut	tsə.mæu
120.	*milk*	miuk	kə.miu	miuk	kə.miu	miuk	kə.miu
121.	*misquote*	mis.kout	tsɨ.koː.mis	mis.kout	tə.koː.mis	mis.kout	kout.mis
122.	*ounce*	oins	sə.oin	ʌws	sə.ʌw	ɒn.s	si.ɒn
123.	*owns*	oŋs	sə.oŋ	oŋs	sə.oŋ	oŋs	sə.oŋ
124.	*ox*	ɒks	sə.oː	ɒks	sə.ɒ	ɒks	sə.ɒ
125.	*participate*	paː.ti.sə.peit	pei.siː.ti.paːt	paɹ.ti.sə.peit	peːt.si.ti.paː	paɹ.tiː.sə.peit	pei.tiː.sə.paː
126.	*peacemaking*	piːs.meː.keŋ	kiŋ.mek.siː.piː	piːs.meː.keŋ	keŋ.mek.piːs	piːs.meː.keŋ	kiŋ.me.piːs
127.	*play*	plei	eipl	plei	ei.plə	plei	ei.plə
128.	*pray*	pɹei	eipɹ	pɹei	ei.pɹə	pɹei	ei.pɹa
129.	*presidency*	pɹeː.si.dən.siː	siː.dən.si.pɹeː	pɹæ.si.dən.siː	siː.dən.siː.pɹeː	pɹʌ.si.dən.siː	siː.dən.siː.pɹeː
130.	*puffs*	pafs	sɨ.paf	pɒfs	si.paf	pɒfs	si.pɒf
131.	*raised*	ɹeist	st.ɹei	ɹeis.ted	dʌt.ɹeis	ɹeis.ted	det.ɹeis
132.	*range*	ɹeinʤ	ʤu.ɹein	ɹeindʒ	dʒuɹ.ɹein	ɹeindʒ	dʒu.ɹein
133.	*recommend*	ɹʌ.kə.mææn	meŋ.kəm.ɹaː	ɹe.kə.mænd	mæŋ.kʌm.ɹaːd	ɹʌ.kə.mand	meŋ.kəm.ɹaːd
134.	*recruiter*	ɹiː.kɹu.təː	ta.kɹud.ɹiː	ɹiː.kɹu.təː	ta.kuɹ.ɹiː	ɹiː.kɹu.təɹ	təː.kɹud.ɹiː
135.	*refrigerator*	ɹiː.fi.dʒu.ɹei.tə	tə.ɹei.dʒiə.fɹiː.ɹei	ɹiː.fi.dʒu.ɹei.təɹ	təː.ɹei.dʒuː.fiː.ɹiː	viː.fi.dʒu.ɹei.təɹ	təː.ɹei.dʒuː.fɹiː.ɹiː
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹiː	ɹi.lei.ʃn.ʃip	ʃip.ʃən.lei.ɹiː	vi.lei.ʃən.ʃeːp	ʃip.ʃən.lei.ɹiː
137.	*representative*	ɹa.pu.sæn.tə.təːf	tiːf.tə.sæm.pi.ɹəː	ɹʌ.pu.sæn.tə.tif	tiːf.tə.sæm.pə.ɹiː	ɹa.pu.sæn.tei.tiːf	tiːf.tei.sem.piː.ɹaː

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃ.ted	det.ɹʌʃ	ɹʌʃ.ted	det.ɹʌʃ	ɹʌʃ.ted	dʌt.ɹʌʃ
139.	*scratch*	skɹætʃ	tʃu.skɹæ	skɹætʃ	tʃes.kɹæt	skɹætʃ	tʃos.kɹæt
140.	*scree*	skɹei	ɹeis	skɹiː	iːs	skɹiː	iːs.kɹi
141.	*segment*	saʔ.mint	tə.mən.saː	saʔ.mənt	tə.mæn.saː	saʔ.mənt	mint.sæːk
142.	*senseless*	sen.si.lʌs	lʌs.si.sæn	sens.lʌs	lʌ.sə.sæn	sens.lʌs	lʌs.sæns
143.	*sequence*	siː.kwens	siː.kwʌn.siː	siː.kwens	kwʌns.siː	siː.kwen.ses	ses.kwen.siː
144.	*shameless*	ʃeim.las	lʌs.ʒeim	ʃeim.lʌs	lʌs.sə.ʃeim	ʃeim.lʌs	lʌs.ʃeim
145.	*shelve*	ʃewf	fi.ʃew	ʃʌuf	fu.ʃau	ʃʌuf	fu.ʃau
146.	*shelved*	ʃauf.det	dʌt.ʃauf	ʃʌuf.det	dʌt.ʃauf	ʃauft	dʌ.ʃauf
147.	*skate*	skeit	tə.skei	skeit	tə.skei	skeit	tə.skei
148.	*skating*	skei.tiŋ	tiŋ.skei	skei.teŋ	teŋ.skei	skei.teŋ	teŋ.skei
149.	*slope*	si.loːp	pəː.sloː	sloːp	pəː.sloː	sloːp	pe.sloː
150.	*small*	smoː	moːs	smoː	moːs	smoː	oːs.maː
151.	*smooth*	smuːθ	fuː.smuː	smuːθ	θuː.smuː	smuːθ	fus.mbuː
152.	*snatch*	snætʃ	tʃus.nɒ	snætʃ	tʃus.naːt	snætʃ	tʃus.naː
153.	*spa*	spaː	aːsp	spa.a	aːs.pə	spaː	aːs.paː
154.	*spare*	s.beəɹ	eː.ʌs.biə	s.beəɹ	əɹs.bə	s.beəɹ	ʌs.bieɹ
155.	*sphere*	spiː.əɹ	iː.ʌs.piː	sfiː.əɹ	əːs.fiː	sfiː.əɹ	iːs.fi.ə
156.	*spiritual*	spiː.ɹi.tɹou	tʃo.ɹi.spiː	spiː.ɹi.tɹou	tʃʌu.ɹi.spiː	spiː.ɹi.tɹou	tʃoː.ɹi.spiː
157.	*splendid*	splʌn.did	dig.splen	splen.dit	dʌt.splen	splen.det	dʌt.splen
158.	*split*	split	tə.spli	split	tə.spli	spliːt	tʃə.spliː
159.	*spoil*	spɒi.ou	ou.spoi	spɒi.oː	ɒis.bə	s.bɒi.ou	ɒis.bə
160.	*spray*	spə.ɹei	eis.bɹ	spɹeːj	eisb.ɹə	spɹei	eis.bɹa

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹeŋ	eŋ.spɹə	spɹeŋ	eŋsp.ɹə	spə.ɹein	eŋs.pɹə
162.	*springs*	spɹeŋs	sʌs.pɹeŋ	spɹeŋs	ses.pɹeŋ	spɹeŋs	sʌs.pɹein
163.	*squeeze*	skwiːz	si.gwiːs	skwiːz	zə.skwiː	skwiːz	sə.skwiː
164.	*stain*	stein	einst	s.dein	eins.də	steːjn	eins.də
165.	*star*	staː	ɹʌs.taː	staːɹ	ɒːs.tə	stlaːɹ	ɒːs.ta
166.	*string*	sɹeiŋ	inz.ɹi	stɹeŋ	eŋs.ɹi	stɹeŋ	eŋs.tɹə
167.	*stupid*	stjuː.bəd	pe.stjuː	stjuː.bed	bʌd.stiu	stjuː.pid	pis.tiu
168.	*suppose*	sʌ.pous	sɨ.pou.sʌp	sʌ.pous	si.pou.sʌp	sʌ.pous	pous.sʌp
169.	*swim*	swim	wims	swim	m.swiː	swim	m.swiː
170.	*text*	tæst	sə.tæt	tæts	si.taː	tæst	si.tæs
171.	*thankful*	θæŋ.k.foː	foː.kə.fæŋ	θæŋ.k.fʌu	foː.kə.θæŋ	θæŋk.fʌu	foː.θæŋk
172.	*trenched*	tɹetʃ.ted	dʌ.tu.tɹæ	tɹentʃ.det	dʌ.tʃu.tɹæn	tʃɹʌntʃ.det	det.tɹæntʃ
173.	*tweet*	twiːt	iːtʃ.twit	twiːt	təː.twiː	twiːt	təː.twiː
174.	*underpaid*	ʌn.də.peid	də.pei.də.ʌn	ʌn.də.peid	də.pei.də.ʌn	ʌn.də.peid	pei.da.ʌn
175.	*understand*	ʌn.də.stæn	stæn.də.ʌn	ʌn.də.stænd	stæn.də.ʌn	ʌn.də.stænd	stæn.də.ʌn
176.	*urge*	əːɹʤ	ʤu.əːɹ	əɹdʒ	dʒe.əɹ	əːɹdʒ	dʒe.əɹ
177.	*Welsh*	weuʃ	ʃu.weu	wauʃ	ʃu.wew	weuʃ	ʃu.wew
178.	*whereabout*	weː.ʌ.bʌut	bʌut.a.ɹeə	weː.ʌ.bʌut	bʌut.ʌ.weə	weː.ʌ.bʌut	bʌut.ʌ.weə
179.	*wolf*	wuːf	fu.woː	wuəf	fə.woː	wuəf	fu.woː
180.	*woodland*	wut.ləːn	lʌn.wəːt	wud.lænd	lænd.wəːd	wud.ə.læn	lænd.wud

V. HK-F-26-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeid	fɹei.ʌ	ʌ.fɹeit	feid.ʌː	ʌ.fɹei	fɹei.ʌ
2.	*age*	eitʃ	tʃei	eːtʃ	tʃei	eitʃ	tʃei
3.	*Alps*	eips	sbei	eips	sbei	eips	sei
4.	*amuse*	ə.mius	miu.sʌː	ʌ.mius	miu.sʌː	ʌ.mius	mius.ʌː
5.	*anguish*	eŋ.gwiʃ	gwi.ʃen	eŋ.gwiʃ	gwiʃ.en	en.gwiʃ	gwiʃ.en
6.	*anklet*	eŋ.klit	klik.en	eŋ.klet	klet.en	eŋ.klet	klet.en
7.	*ant*	ænt	tæn	ænt	tæn	ant	tan
8.	*approve*	ə.pɹuːf	pɹuf.ʌː	ʌ.pɹuːf	pɹuf.ʌː	ʌ.pɹuf	pɹuf.ʌː
9.	*ask*	aːsk	kaːs	aːsk	ksaː	aːsk	kaː
10.	*asked*	aːskt	kaːs	askt	kaː	askt	saː
11.	*asks*	ask	sas	aːsks	sksaː	asks	kaː
12.	*bangs*	bæŋs	sŋæː	bæŋs	sŋæm	bæŋs	sŋæm
13.	*begged*	bæk	gæp	bækt	dæp	bæːk	gæːp
14.	*begs*	bæks	sgæp	bæks	sgæp	bæks	sæp
15.	*blast*	blaːst	taː	blaːst	sdaːp	blaːst	sdaːp
16.	*bled*	blet^{h}	dep	blet	dep	blet	dep
17.	*bloom*	blum	mum	blum	mum	blom	momp
18.	*blunt*	blʌnt	tʌn	blʌnt	tʌm	blʌnt	tʌm
19.	*blur*	bləː	ɹəːp	bləː	əːp	bləː	əːp
20.	*brief*	bɹif	fɹip	bɹif	fip	bɹif	fip
21.	*Britain*	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	tən.bɹi
22.	*bronze*	bɹans	swamp	bɹans	snam	bɹaŋs	sam

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biu	diu	biu	wiu	biut	diup
24.	*bulb*	bʌp	bʌp	bʌp	bʌp	bʌp	bʌp
25.	*bulbs*	bʌps	sbʌp	bʌps	sbʌp	bʌps	sbʌp
26.	*cashback*	kæʃ.bæk	bæ.kæʃ	kæʃ.bæk	bæ.kæʃ	kæʃ.bæk	bæ.kæʃ
27.	*clarify*	kæ.ɹə.fai	fai.ɹə.kæ	klæ.wə.fai	fai.ɹə.klæ	klæ.wə.fai	fai.ɹə.klæ
28.	*Clark*	klaɹk	kal	klak	klak	klak	kak
29.	*clear*	kliʌ	ʌ.kli	kli.ʌ	ʌ.kli	kliʌ	ʌ.kliː
30.	*cliff*	klif	filk	klif	flik	klif	fik
31.	*close*	klous	souk	klous	souk	klous	souk
32.	*closure*	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou
34.	*clubbed*	klʌp.də	də.klʌp	klʌpt	bʌpk	klʌpt	bʌpk
35.	*Constantine*	kon.stən.tin	tin.stən.kon	koŋ.stə.tən	tən.stə.kon	kon.stən.tən	tən.stən.kon
36.	*corpse*	kops	sbok	kops	sbok	kops	sbok
37.	*crawl*	kɹoː	loː	kwoː	loːk	kɹoː	woːk
38.	*crisp*	kɹips	sbɹipk	kɹis	sbik	kɹisp	sbik
39.	*crow*	kɹou	ouk	kɹou	ɹouk	kɹou	ouk
40.	*crown*	kɹan	ɹan	kɹaun	naunk	kɹaun	naunk
41.	*cry*	kɹai	aik	kɹai	jaik	kɹai	aik
42.	*cube*	kyp	byk	kyp	byk	kyp	byk
43.	*digest*	dʌi.dʒest	dʒes.dʌi	dʌi.dʒes	dʒes.dʌi	dʌi.dʒes	dʒes.dʌi
44.	*disband*	dis.bent	ben.dis	dis.ben	ben.dis	dis.bænt	ben.dis
45.	*disclaim*	dis.kleim	kleim.dis	dis.kleim	kleim.dis	dis.kleim	kleim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.kʌs	kʌs.dis	dis.kʌs	kʌs.dis	dis.kʌs	kʌs.dis
47.	*dumped*	dʌmt	tsʌmt	dʌmt	tʌm	dʌmt	pʌm
48.	*east*	ist	tɕiː	ist	stiː	ist	siː
49.	*eats*	its	si	its	siː	is	stiː
50.	*Ed*	et	de	e	e	e	e
51.	*edge*	etʃ	tʃe	etʃ	tʃeː	etʃ	tʃet
52.	*elf*	elf	fel	ef	feː	elf	fel
53.	*else*	els	sel	els	sel	els	swel
54.	*elves*	elfs	sfel	elfs	sfel	elvs	svel
55.	*encourage*	in.kə.ɹitʃ	ɹitʃ.kə.in	in.kə.ɹitʃ	ɹitʃ.kə.in	in.kə.ɹitʃ	ɹitʃ.kə.in
56.	*encouraging*	iŋ.kə.ɹei.dʒiŋ	dʒiŋ.ɹi.kə.in	in.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	iŋ.kə.ɹei.dʒiŋ	dʒiŋ.ɹi.kə.in
57.	*English*	iŋ.gliʃ	gliʃ.iŋ	iŋ.liʃ	gliʃ.iŋ	iŋg.liʃ	gliʃ.iŋ
58.	*ex-con*	eks.koːn	koːn.eks	eks.kon	kon.eks	eks.kon	kon.eks
59.	*excuse*	iks.kius	kiu.iks	iks.gius	kius.iks	iks.gius	gius.iks
60.	*exhale*	iks.hel	hel.iks	iks.hel	hel.iks	iks.hel	hel.iks
61.	*explode*	iks.blout	bloud.iks	iks.blou	blou.iks	iks.blou	blou.iks
62.	*fabric*	fɹe.bik	bɹik.fe	fææ.bɹik	bɹik.fæː	fɹæ.bɹik	bɹik.fæː
63.	*fact*	fækt	tæf	fækt	tæf	fækt	tæf
64.	*famed*	feimt	demf	feimt	meinf	feimt	meinf
65.	*fed*	fætʰ	dæf	fed	def	feːtʰ	deːf
66.	*film*	fim	mim	fim	mif	fim	mif
67.	*fish*	fiʃ	ʃif	fiʃ	ʃfiːf	fiʃ	ʃif
68.	*flap*	flæp	pæf	flæp	pæf	flæp	pæf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	fləːɹt	təːɹf	flət	təf	flət	təf
70.	*flu*	fluː	uːf	fluː	uːf	fluː	uːf
71.	*fly*	flai	aif	flai	aif	flai	aif
72.	*foolish*	fu.liʃ	liʃ.fu	fu.liʃ	liʃ.fu	fu.liʃ	liʃ.fu
73.	*frank*	fɹeŋk	kɹenf	fɹeŋk	kɹenf	fɹeŋk	kwenf
74.	*Franks*	fɹæŋks	skɹænf	fɹæŋks	sænf	fɹeŋks	skenf
75.	*free*	fɹiː	iːf	fɹiː	iːf	fɹiː	iːf
76.	*freshness*	fɹeʃ.nəs	nəs.fɹeʃ	fɹeʃ.nəs	nəs.fɹeʃ	fɹeʃ.nəs	nəs.feʃ
77.	*friend*	fɹent	twenf	fɹent	dwenf	fɹent	dwenf
78.	*fringe*	fɹintʃ	tʃinf	fɹintʃ	tʃinf	fɹintʃ	tʃwinf
79.	*games*	geːms	smeːŋ	geims	smeiŋ	gems	smein
80.	*gasped*	gæpst	pæks	gæpt	pæː	gæsp	sæk
81.	*gasps*	gæps	sæk	gæps	sæːk	gæsps	sbæː
82.	*gave*	geif	fei	geif	fei	geif	fei
83.	*glue*	gluː	uː	gluː	uː	gluː	uː
84.	*grab*	gɹe	fɹe	gɹep	bɹe	gɹep	bɹek
85.	*grant*	gɹʌŋt	twʌn	gɹʌŋt	twʌŋ	gɹʌŋt	twʌŋ
86.	*grape*	gɹei	bɹei	gɹeip	bɹei	gɹeip	pɹei
87.	*help*	help	pel	help	pel	help	pel
88.	*helped*	helpt	tɕel	helpt	pel	helpt	belh
89.	*hobnob*	hop.no	nop.hop	hop.nop	nop.hop	hop.nop	nop.hop
90.	*implore*	im.blo.ʌ	ʌ.blo.im	im.ploː	plo.im	im.ploː	plo.im
91.	*improve*	im.pɹuːf	pɹuf.in	im.pɹuf	pɹuf.im	im.pɹuf	pɹuf.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	iŋ.kɹi.siŋ	siŋ.kɹi.in	iŋ.kɹi.siŋ	siŋ.kɹi.in	iŋ.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fi.nit	nit.fən.de.in	in.de.fi.nit	nit.fən.de.in	in.de.fi.nit	nət.fən.de.in
95.	*independent*	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dən.pen.di.in
96.	*inflict*	in.flet	flet.iːn	in.fleit	fleit.in	in.flekt	flekt.in
97.	*infuse*	in.fius	fiu.sin	in.fius	fiu.sin	in.fius	fius.in
98.	*ink*	iŋk	kiŋ	iŋk	kiŋ	iŋk	kiŋ
99.	*inked*	iŋkt	kiŋ	iŋkt	tiŋk	iŋkt	kiŋ
100.	*inks*	iŋks	siŋ	iŋks	siŋ	iŋks	sgiŋ
101.	*instinct*	in.sdiŋ	sdiŋ.in	in.sdiŋ	sdiŋ.in	in.sdiŋt	sdiŋt.in
102.	*instrument*	in.ʃu.mən	mən.ʃu.in	in.ʃu.mənt	mən.ʃə.in	ins.ʃə.mənt	məns.ʃə.in
103.	*i-Tunes*	ʌi.tyns	tyn.sʌi	ʌi.tyns	tuns.ʌi	ʌi.tuns	tuns.ʌi
104.	*jasmine*	dʒes.mən	mən.dʒes	dʒes.mən	mən.dʒes	dʒes.mən	mən.dʒes
105.	*jumps*	dʒʌms	sʌm	dʒʌms	sbʌm	dʒʌms	sʌm
106.	*kept*	kept	tek	kept	tepk	kept	bek
107.	*lapse*	læps	sæl	læps	spæl	læps	sbæː
108.	*lapsed*	læpst	sbæl	læpst	sbæː	læpst	bæː
109.	*larks*	laːks	skaː	laːks	sgaː	laks	saː
110.	*lend*	lent	den	len	den	len	den
111.	*lift*	lift	tif	left	fel	lift	fil
112.	*lisp*	lips	slip	lips	sbil	lisp	siː
113.	*lived*	lift	twif	liːft	fiːf	lift	fil
114.	*lives*	laifs	sfai	laifs	sfai	laifs	sfai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	koː	lok	kok	lok	koː
116.	*log*	lo:k	goː	loː	goː	loː	oː
117.	*lump*	lʌm	pʌm	lʌm	mʌm	lʌm	mʌm
118.	*matched*	mætʃt	tʃmæ	mætʃt	tʃæm	mætʃ	tʃæm
119.	*melt*	melt	telm	melt	telm	melt	telm
120.	*milk*	miuk	kium	miuk	kjum	mjuk	kjum
121.	*misquote*	mis.kwout	kwout.mis	mis.kɹout	kɹout.mis	mis.kɹout	kɹout.mis
122.	*ounce*	auns	saun	auns	saun	auns	saun
123.	*owns*	oŋs	snoŋ	oŋs	snoŋ	oŋs	soŋ
124.	*ox*	o:s	soː	o:s	soː	o:s	soː
125.	*participate*	pʌ.ti.si.pei	pei.ti.si.pʌ	pʌ.ti.sə.pei	pei.si.ti.pʌ	pʌ.ti.sə.pei	pei.si.ti.pʌʌ
126.	*peacemaking*	pis.mek.kiŋ	kiŋ.mek.piːs	pis.mek.kiŋ	kiŋ.mek.piːs	pis.mek.kiŋ	kiŋ.mek.pis
127.	*play*	plei	ei	plei	eip	plei	eip
128.	*pray*	pɹei	eip	pɹei	eip	pɹei	eip
129.	*presidency*	pɹe.sə.dən.si	si.dən.si.pɹe	pɹe.sə.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	fʌp	pʌfs	sfʌp	pʌfs	sfʌp
131.	*raised*	ɹeist	tʃei	ɹeist	tseiw	ɹeist	stɹei
132.	*range*	ɹeintʃ	tʃein	ɹeintʃ	tʃein	ɹeintʃ	tʃein
133.	*recommend*	ɹe.kə.ment	men.kən.ɹe	ɹe.kəm.men	men.kəm.ɹe	ɹe.kəm.ment	men.kəm.ɹe
134.	*recruiter*	ɹi.kut.tʌ	tʌ.kut.ɹi	ɹi.kut.tʌ	tʌ.kwə.ɹi	ɹi.kut.tʌ	tʌ.ku.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒi.ɹei.tʌ	tʌ.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒi.ɹei.tə	tʌ.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹə.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pə.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pə.ɹe

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	ʃʌːt	ɹʌʃt	ʃʌt	ɹʌʃt	ʃʌː
139.	*scratch*	sgwetʃ	tʃæs	sgwetʃ	tʃœks	sgɹetʃ	tʃes
140.	*scree*	skɹiː	kɹiːs	sgɹiː	ius	sgɹiː	gɹiːs
141.	*segment*	seʔ.mən	mən.se	seʔ.mən	mən.se	se.mən	mən.se
142.	*senseless*	sens.ləs	lə.sens	sens.ləs	lə.sens	sens.ləs	ləs.sens
143.	*sequence*	si.kwəns	kwən.siː	si.kwəns	kwən.si	si.kwəns	kwən.siː
144.	*shameless*	ʃein.ləs	lə.ʃein	ʃem.ləs	ləs.ʃeim	ʃem.ləs	ləs.ʃeim
145.	*shelve*	ʃelf	felʃ	ʃelf	felʃ	ʃelf	felʃ
146.	*shelved*	ʃelft	felʃ	ʃeift	feiʃ	ʃeif	feiʃ
147.	*skate*	sgeit	teiks	sgeit	teiks	sgeːt	teiks
148.	*skating*	sgeː.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei
149.	*slope*	slop	pəps	slop	pops	slup	bups
150.	*small*	smoː	loːms	smoː	noːms	smoː	oːms
151.	*smooth*	smuːθ	fuːms	smuf	fums	smuf	fums
152.	*snatch*	snetʃ	tʃnes	snetʃ	tʃens	snetʃ	tʃens
153.	*spa*	sbaː	aːps	sbaː	aːps	sbaː	aːps
154.	*spare*	sbe.ʌ	ʌ.sbeː	sbe.ʌ	ʌ.sbeː	sbe.ʌ	ʌ.sbeː
155.	*sphere*	sfi.ə	ʌ.sfi	sfi.ə	ə.sfi	sfi.ʌ	ʌ.sfi
156.	*spiritual*	sbi.ɹi.tʃou	tʃou.ɹi.sbi	sbɹi.ɹi.tʃo	tʃou.ɹi.sbɹi	sbɹi.ɹi.tʃou	tʃou.ɹi.sbɹi
157.	*splendid*	sblen.də	də.sblen	sblen.de	də.sblen	sblen.de	də.sblen
158.	*split*	sblit	tips	sblit	tips	sblit	tips
159.	*spoil*	sbo.jo	ou.sboi	sbo.jo	ou.sboi	sbo.jo	ou.sboi
160.	*spray*	spɹei	pɹeis	spɹei	ɹeips	spɹei	eips

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	uiŋps	sbɹiŋ	uims	sbɹiŋ	eːŋps
162.	*springs*	sbɹiŋs	siŋ.ŋimps	sbɹiŋs	s.eŋps	sbɹiŋs	sɹims
163.	*squeeze*	sgwiːs	swiːs	sgwiːs	sgwiːs	sgwis	sgwis
164.	*stain*	sdeŋ	neŋs	sdeŋ	deŋs	sdeŋ	eŋst
165.	*star*	sdaː	ɹaːst	sdaː	aːs	sdaː	aːs
166.	*string*	sdɹiŋ	uiŋs	sdɹiŋ	ɹiŋts	sdɹiŋ	gɹiŋs
167.	*stupid*	sdju.bit^h	bə.sdju	sdju.bet	bə.sdju	sdju.bet^h	bə.sdju
168.	*suppose*	sʌp.pous	pou.sʌp	sʌp.pous	pou.sʌp	sʌp.pous	pou.sʌp
169.	*swim*	swim	mims	swim	mims	swin	mius
170.	*text*	test	stæt	tekst	stekt	tekst	stekt
171.	*thankful*	θæŋ.fou	fou.θæŋ	θæŋk.fou	fou.θæŋk	θæŋ.fou	fou.θæŋ
172.	*trenched*	tʃentʃt	tentʃ	tɹentʃt	nentʃ	tɹentʃt	tɹent
173.	*tweet*	twit	tiu	twit	tiut	twit	twit
174.	*underpaid*	ʌn.də.pei	pei.də.ʌn	ʌn.də.pei	pei.də.ʌn	ʌn.nə.pei	pei.də.ʌn
175.	*understand*	ʌn.də.sdænt	sdæn.ʌn.də	ʌn.də.sdæn	sdæn.də.ʌn	ʌn.də.sdænt	sdæn.də.ʌn
176.	*urge*	əɹtʃ	tʃəɹ	ətʃ	tʃəːɹ	ətʃ	tʃəː
177.	*Welsh*	welʃ	ʃel	welʃ	ʃel	welʃ	ʃel
178.	*whereabout*	weə.ʌ.bʌut	bʌu.tʌ.weː	weə.ʌ.bʌut	ə.bʌut.weə	weə.ʌ.bʌut	ə.bʌut.weə
179.	*wolf*	wuːf	fuː	wof	fuː	wuf	fuː
180.	*woodland*	wu.lən	len.wu	wu.lən	lən.wut	wu.lənt	lən.wut

VI. HK-F-27-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹei	fɹei.aː	ʌ.fɹei	fɹei.daː	ʌ.fɹeid	fɹei.daː
2.	*age*	eidʒ	tʃeIn	eidʒ	tʃei	eidʒ	tʃei
3.	*Alps*	eups	speu	eups	seu	æups	spæu
4.	*amuse*	ʌ.mjuːs	mju.aːs	ə.mjuːs	mju.saː	ʌ.mjuːs	mjus.aː
5.	*anguish*	æŋ.gwiʃ	gwiʃ.en	æŋ.gwiʃ	gwiʃ.en	æŋ.gwiʃ	gwiʃ.en
6.	*anklet*	æŋ.klit	klət.æn	æŋ.klet	klʌt.en	æŋ.klet	klʌt.en
7.	*ant*	ænt	tæn	ent	ten	ent	ten
8.	*approve*	ʌ.pɹuːf	pɹuːf.aː	ʌ.pɹuːf	pɹuf.aː	ʌ.pɹuːf	pɹuf.aː
9.	*ask*	aːsk	skaː	aːsk	skaː	aːsk	skaː
10.	*asked*	aːskt	skaː	æskt	taː	aːskt	skaː
11.	*asks*	aːsks	saː	aːsks	skaː	asks	skaː
12.	*bangs*	bæŋgs	sæm	bæŋgs	sæm	bæŋs	skeːm
13.	*begged*	bækt	gdæp	bækt	gæp	bækt	ktæp
14.	*begs*	bæks	skæp	bæks	sæːp	beːks	skeːp
15.	*blast*	blest	step	blest	step	blest	stæp
16.	*bled*	blet	dep	bled	dep	bleːd	deːb
17.	*bloom*	bluːm	muːp	bluːm	muːv	bluːm	muːp
18.	*blunt*	blʌnt	tʌm	blʌnt	tʌm	blʌnt	tʌm
19.	*blur*	bləː	əːp	bləː	əːb	bləː	əːb
20.	*brief*	bɹiːf	fiːp	bɹiːf	fiːb	bɹiːf	fiːp
21.	*Britain*	bɹit.tən	tʌn.bɹiː	bɹi.tən	tʌm.bɹit	bɹi.tən	tʌm.bɹit
22.	*bronze*	bɹɒːns	sɒːm	bɹɒns	snɒːp	bɹɒns	sɒːm

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	bil	dil	bild	diup	biud	diup
24.	*bulb*	bap	bʌp	bap	bap	bap	bap
25.	*bulbs*	bʌlps	spɒb	baps	spab	baps	spab
26.	*cashback*	kæʃ.pæk	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ	kæʃ.bak	bæk.kæʃ
27.	*clarify*	klæ.ɹə.fa:j	fai.ɹi.klæ:	klæ.ɹə.fa:j	fai.ɹi.klæ:	klæ.ɹə.faɹj	fai.ɹi.klæ:
28.	*Clark*	kla:k	ka:k	kla:k	ka:k	kla:k	ka:k
29.	*clear*	kli:.ə	a:.kli:	kli.ə	ə:.kl:	kli.ə	ə:.kli
30.	*cliff*	klif	fi:k	klif	fik	klif	fik
31.	*close*	kl̥ous	souk	klous	so:wk	klous	so:wk
32.	*closure*	klou.ʃə	ʃə:.klou	klou.ʃə:	ʃə:.klou	klou.ʒə:	ʃə:.klou
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θeŋ	θiŋ.klou
34.	*clubbed*	klʌpt	tʌk	klapt	bapk	klʌpt	tʌk
35.	*Constantine*	kɒn.stʌn.ti:n	ti:n.steŋ.kɒn	kɒn.stʌn.ti:n	ti:n.steŋ.kɒ:n	kɒn.stʌn.ti:n	ti:n.ste.n(i).kɒ:n
36.	*corpse*	kɒps	sɒpk	kɒps	spɒk	kɒps	spɒk
37.	*crawl*	kɹɒ:	ɒ:k	kɹɒ:	ɒ:k	kɹɒ:	ɒ:k
38.	*crisp*	kɹisp	spi:k	kɹisp	spik	kɹisp	spik
39.	*crow*	kɹou	wouk	kɹɒ:	ɒ:k	kɹou	ouk
40.	*crown*	kɹauŋ	nauŋk	kɹaun	nauŋk	kɹaun	nauŋk
41.	*cry*	kɹai	aik	kɹai	aik	kɹai	aik
42.	*cube*	kju:b	bju:k	ky:p	byk	ky:p	byk
43.	*digest*	dai.ʤest	ʤes.dai	dai.ʤest	ʤes.dai	dai.dʒest	dʒes.dai
44.	*disband*	dis.bæn	bæn.dis	dis.bæn	bæn.dis	dis.bæn	bæn.dis
45.	*disclaim*	dis.kleim	kleim.dis	dis.kleim	kleim.dis	dis.kleim	kleim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.ka:s	gʌs.dis	dis.gjas	gjʌs.dis	dis.gjas	gjʌs.dis
47.	*dumped*	dʌmt	tʌmd	dʌmt	tʌm	dʌmt	tʌm
48.	*east*	i:st	stiː	i:st	stiː	i:st	stiː
49.	*eats*	i:ts	tsiː	i:ts	tsiː	i:ts	tsiː
50.	*Ed*	e:t	deː	æ:d	deː	æ:d	deː
51.	*edge*	ætʃ	tʃeː	ætʃ	tʃeː	ætʃ	tʃeː
52.	*elf*	æuf	fæu	æuf	fæu	æuf	fæu
53.	*else*	eus	seu	aus	seu	eus	seu
54.	*elves*	æufs	sæu	æufs	sfæu	æufs	sfæu
55.	*encourage*	eŋ.kʌ.ɹeitʃ	ɹeitʃ.kəː.en	eŋ.kʌ.ɹeitʃ	ɹeitʃ.kəː.æn	eŋ.kʌ.ɹeitʃ	ɹeitʃ.kəː.æn
56.	*encouraging*	eŋ.kʌ.ɹei.dʒiŋ	dʒiŋ.ːei.kəɹ.eːn	eŋ.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kəɹ.eːn	eŋ.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kəɹ.eːn
57.	*English*	eŋ.gliʃ	gliʃ.eŋ	eŋ.gliʃ	gliʃ.eŋ	eŋ.gliʃ	gliʃ.eŋ
58.	*ex-con*	eks.kɒn	kɒ.neks	eks.kɒn	kɒn.eks	eks.kɒn	kɒ.neks
59.	*excuse*	eks.kju:s	skju:s.eks	eks.kju:s	skju:s.eks	eks.kju:s	gju:s.eks
60.	*exhale*	eks.hæu	hæu.eks	eks.he.ou	ou.heu.eks	eks.heː.ou	ou.heː.eks
61.	*explode*	eks.ploud	bɭou.eks	eks.ploud	bloud.eks	eks.ploud	bloud.eks
62.	*fabric*	fæ.bɹik	bɹik.fæ	fɹæ.bɹik	bɹik.fæ	fæ.bɹek	bɹik.fæ
63.	*fact*	fækt	ktæf	fækt	kæft	fækt	ktæf
64.	*famed*	feind	deif	feind	deiɱf	fein	deiɱf
65.	*fed*	fe:d	de:f	fe:d	def	fe:d	def
66.	*film*	fium	mif	film	mif	fium	mif
67.	*fish*	fiʃ	ʃif	fiʃ	ʃif	fiʃ	ʃif
68.	*flap*	flæp	pæf	flæ:p	pæ:f	flæ:p	pæ:f

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flə:t	tə:f	flət	təf	flə:t	tə:f
70.	*flu*	flu:	u:f	fɭu:	u:f	flu:	u:f
71.	*fly*	fla:j	a:jf	fla:j	a:jf	fla:j	a:f
72.	*foolish*	fu:.liʃ	litʃ.fu:	fu:.liʃ	liʃ.fu:	fu:.liʃ	liʃ.fu:
73.	*frank*	fɹæŋk	kæɱf	fɹæŋk	kæɱf	fɹæŋk	kæɱf
74.	*Franks*	fɹæŋs	sæŋf	fɹæŋs	skænf	fɹæŋks	skænf
75.	*free*	fɹi:	i:f	fɹi:	i:f	fɹi:	i:f
76.	*freshness*	fɹeʃ.nis	nʌs.fɹeʃ	fɹeʃ.nes	nʌs.fɹeʃ	fɹæʃ.nes	nʌs.fɹʌʃ
77.	*friend*	fɹent^h	denf	fɹent^h	deɱf	fɹent^h	deɱf
78.	*fringe*	fɹintʃ	tʃinf	fɹintʃ	tʃimf	fentʃ	tʃiɱf
79.	*games*	geims	smei	geims	smæ:ŋ	geims	smeiŋ
80.	*gasped*	gesp	spæg	gesp	spæg	gespt	spæk
81.	*gasps*	ga:sps	spa:g	gesps	spæg	ge:sps	spæ:g
82.	*gave*	geif	feik	geif	feig	geif	feig
83.	*glue*	glu:	u:f	glu:	u:g	glu:	u:g
84.	*grab*	gɹæp	bæk	gɹæp	bæk	gɹæ:p	bæ:k
85.	*grant*	gɹa:nt	ta:n	gɹa:nt	ta:ŋ	gɹa:nt	ta:ŋ
86.	*grape*	gɹeip	peik	gɹeip	peik	gɹe:p	pe:g
87.	*help*	hæup	peu	hæup	peu	hæup	pæu
88.	*helped*	hæupt	tæu	hæupt	tæu	hæupt	teu
89.	*hobnob*	hɒt.nɒp	nɒb.hɒp	hɒt.nɒp	nɒt.hɒp	hɒt.nɒ	nɒb.hɒp
90.	*implore*	im.pɭo:	pɭɒ.im	im.plo:.ʌ	ʌ.plo:.im	im.plo:	plɒ.jim
91.	*improve*	im.pɹu:f	pɹu:f.im	im.pɹu:f	pɹu:.vin	im.pɹu:f	pɹu:f.i:m

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	iŋ.kɹiː.ziŋ	seŋ.kɹiː.en	iŋ.kɹiː.zeŋ	seŋ.kɹiː.in	iŋ.kɹiː.seŋ	seŋ.kɹiː.iːn
94.	*indefinite*	in.dæ.fi.nəʔ	nʌ.fiː.də.iːn	in.dæ.fi.nət	nʌt.dæ.fi.in	in.dæ.fi.nəʔ	nʌ.fi.dæ.iːn
95.	*independent*	in.di.pæn.dən	dʌm.pen.diː.en	in.di.pen.dən	dʌm.pen.diː.in	in.di.pæn.dən	dʌm.pen.diː.in
96.	*inflict*	in.flikt	flikt.in	iɱ.flekt	flekt.in	iɱ.flekt	flekt.in
97.	*infuse*	iɱ.fjuːs	fjuːs.in	iɱ.fius	fjuːs.in	iɱ.fius	fjuːs.in
98.	*ink*	eŋk	kin	eŋk	kiŋ	eŋk	keŋ
99.	*inked*	iŋkt	ktiŋ	eŋkt	keŋ	eŋkt	ktiŋ
100.	*inks*	eŋks	siŋ	eŋks	skiŋ	eŋgs	skeŋ
101.	*instinct*	in.steŋt	steŋ.in	in.steŋ	steŋ.in	in.steŋ	steŋ.in
102.	*instrument*	in.stɹu.men	mʌn.stɹuɹ.in	in.stɹə.ment	mʌn.stɹuː.in	ins.tɹo.mənt	mʌn.stɹuː.iːn
103.	*i-Tunes*	ai.tuːns	tuːns.ai	ai.tuːns	tunz.ai	ai.tuːns	tuːns.ai
104.	*jasmine*	dʒes.mən	min.dʒes	dʒæs.mən	mʌn.dʒes	dʒæs.mən	mən.dʒes
105.	*jumps*	dʒʌms	sʌmdʒ	dʒʌmps	spʌmʒ	dʒamps	samdʒ
106.	*kept*	kept	tek	kæpt	tæk	kæːpt	tæːpk
107.	*lapse*	læps	spæʊ	læps	spæʊ	læps	spæʊ
108.	*lapsed*	læpst	stæ	læpst	stæp	læpst	stæwp
109.	*larks*	laːks	skaːl	laːks	skaː	laːks	skal
110.	*lend*	len	den	lænt^{h}	dæn	lænt	dæn
111.	*lift*	lift	til	lift	ftiu	lift	ftiu
112.	*lisp*	lisp	spil	lisp	spil	lipsp	spiu
113.	*lived*	lift	dil	lift	ftil	lift	ftiu
114.	*lives*	liːvs	fsiːj	laifs	sfai.o	laifs	sfai.ou

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lɒk	kɒː	lɒːk	kɒː	lɒːk	kɒː
116.	*log*	lɒg	gɒː	lɒːg	gɒː	lɒːg	gɒː
117.	*lump*	lʌm	pʌm	lʌmp	pʌm	lʌmp	pʌm
118.	*matched*	mætʃt	tæm	mætʃt	tʃæm	mætʃt	ʃtæm
119.	*melt*	maut	teum	maut	teum	meut	teum
120.	*milk*	miuk	kjum	meuk	kjum	milk	kjum
121.	*misquote*	mis.kwout	kous.mits	mis.kwout	koː.mis	mis.kwout	kwout.mis
122.	*ounce*	aus	sau	aus	sauŋ	aus	saum
123.	*owns*	əuns	soun	ous	soun	oms	snou
124.	*ox*	ɒks	sɒ	ɒks	sɒ	ɒks	skɒ
125.	*participate*	pʌ.ti.sə.peit	pei.si.tə.pət	pʌ.ti.sə.peit	pei.si.ti.pət	pʌ.ti.sə.peit	pei.si.ti.pət
126.	*peacemaking*	piːs.me.kiŋ	keŋ.mek.piːs	piːs.me.kiŋ	kiŋ.mek.piːs	piːs.me.kiŋ	kiŋ.mek.piːs
127.	*play*	plei	eipl	plei	eip	plei	eip
128.	*pray*	pɹei	eip	pɹei	eip	pɹei	eip
129.	*presidency*	pɹæ.si.dən.siː	siɹ.dən.sə.pɹæ	pɹæ.si.dən.siː	siː.dəm.pɹæ.siːʔ	pɹæ.si.dən.siː	siː.dən.sə.pɹeː
130.	*puffs*	pʌfs	fsʌp	paːfs	sfʌp	paːfs	sfaːp
131.	*raised*	ɹeist	stei.əɹ	ɹeist	stei.əɹ	ɹeist	steəɹ
132.	*range*	ɹeindʒ	tʃein	ɹeindʒ	tʃein	ɹeːŋdʒ	tʃeiŋ
133.	*recommend*	ɹe.kə.meːnd	meːŋ.kʌm.ɹæː	ɹe.kə.meːnd	meːŋ.kʌm.(b)ɹæː	ɹe.kə.meːnd	meːŋ.kəm.ɹæː
134.	*recruiter*	ɹiː.ku.taː	təː.kɹuʔ.wiː	ɹiː.ku.taː	taː.kɹuʔ.wiː	ɹiː.ku.taː	taː.kɹud.wiː
135.	*refrigerator*	ɹi.fi.dʒu.ɹei.ta	tʌ.ɹei.dʒi.fiː.ɹiː	ɹiː.fi.dʒu.ɹei.taː	tʌ.ɹei.dʒə.fiː.ɹiː	ɹi.fi.dʒu.ɹei.taː	tʌ.ɹei.dʒə.fiʔ.ɹiː
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃʌn.lʌi.ɹiː	ɹi.lei.ʃən.ʃiːp	ʃip.ʃʌm.lʌi.ɹiː	ɹi.lei.ʃən.ʃiːp	ʃip.ʃʌn.lʌi.ɹiː
137.	*representative*	ɹæ.pə.zæn.tə.tif	tif.ti.sæn.ɹʌ.piː	ɹæ.pi.zæn.tə.tif	tif.te.sæn.ɹə.piː	ɹæ.pi.zæn.tə.tif	tif.tə.sæn.ɹə.piː

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	ʃtəː	ɹʌʃt	ʃtəː	ɹaʃt	ʃtad
139.	*scratch*	skɹætʃ	tʃesk	skɹætʃ	tʃesk	skɹætʃ	tʃæsk
140.	*scree*	skɹiː	iːsk	skɹiː	iːsk	skɹiː	iːsk
141.	*segment*	seg.mən	mʌn.sek	seʔ.mʌn	mʌn.seʔ	seg.mən	mʌn.sæʔ
142.	*senseless*	sens.ləs	lʌs.sens	sens.lis	lʌs.sens	sens.ləs	lʌs.sens
143.	*sequence*	siː.kwens	kwʌn.siː	siː.kwens	kwun.siː	siː.kwenz	kwʌn.siː
144.	*shameless*	ʃeim.ləs	lʌs.ʃeim	ʃeim.lʌs	lʌs.ʃeim	ʃeim.lʌs	lʌs.ʃeim
145.	*shelve*	ʃæuf	fæuʃ	ʃeuf	feuʃ	ʃæuf	fæuʃ
146.	*shelved*	ʃæuft	tæuʃ	ʃauft	fauʃ	ʃæuft	ftæuʃ
147.	*skate*	skeit	teisk	skeit	teisk	skeit	teisk
148.	*skating*	skei.tiŋ	teŋ.skei	skei.tiŋ	tiŋ.skei	skei.teŋ	teŋ.skei
149.	*slope*	sloup	pous	sloup	pous	sloup	pous
150.	*small*	smɒː	ɒɒs	smɒː	ɒms	smɒː	ɒms
151.	*smooth*	smuːf	fuːs	smuːf	fuːs	smuːf	fuːms
152.	*snatch*	snætʃ	tʃes	snætʃ	tʃes	snætʃ	tʃæs
153.	*spa*	spaː	aːsp	spaː	aːsp	spaː	aːsp
154.	*spare*	speː.ə	aːs.be	speː.a	aːs.be	speː.a	aːs.peː
155.	*sphere*	sfiː.ə	əː.sfiː	sfiː.əː	əː.sfiː	sfiː.əː	əːs.viː
156.	*spiritual*	spiː.ɹi.tʃʌu	tʃʌu.ɹis.biː	spiː.ɹi.tʃʌu	tʃʌu.ɹis.biː	spiː.ɹi.tʃʌu	tʃʌu.ɹis.biː
157.	*splendid*	splen.did	dis.plen	splen.did	dis.plen	splen.did	dʌs.plen
158.	*split*	split	tisp	split	tisp	split	tisp
159.	*spoil*	spɒi.ou	ous.boj	spɒi.ou	ou.spɒi	spɒi.ou	ou.spɒi
160.	*spray*	spɹei	eisp	spɹei	eist	spɹei	eisp

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹeiŋ	eːŋs	spɹeiŋ	eŋsp	spɹein	eŋsp
162.	*springs*	spɹeŋs	seŋsp	spɹeŋs	eŋsp	spɹeiŋs	skeːŋsp
163.	*squeeze*	skwiːs	siːsk	skwiːs	siːskw	skwiːs	siːsk
164.	*stain*	stein	neinst	steːŋ	neiŋst	steːŋ	neŋst
165.	*star*	staː	aːst	staː	aːst	staː	aːst
166.	*string*	stɹiŋ	iŋstɹ	stɹeŋ	eŋst	stɹeŋ	eŋst
167.	*stupid*	stjuː.bəd	bʌs.tjuː	stjuː.bid	bʌ.stjuː	stjuː.bid	bʌ.stuː
168.	*suppose*	sə.poʊs	poʊ.sʌp	sʌ.pous	pou.saːp	sʌ.pous	pous.saːp
169.	*swim*	swim	mins	swiːm	mins	swim	mins
170.	*text*	tekst	sket	tækst	sket	tækst	skæt
171.	*thankful*	θæŋk.foː	fou.θæŋ	θæŋk.foː	fou.θæŋk	θæŋk.fou	fou.θæŋk
172.	*trenched*	tɹentʃt	tʃent	tɹæntʃt	tʃent	tɹæntʃt	tʃent
173.	*tweet*	twiːt	tiːt	twiːt	tiːt	twiːt	tiːt
174.	*underpaid*	ʌn.də.pei	pei.də.an	ʌn.də.peit	pei.də.an	ʌn.də.peid	pei.də.an
175.	*understand*	ʌn.də.stænt^h	stæn.də.an	ʌn.də.stænt^h	stæn.də.an	ʌn.də.stænt^h	sten.də.an
176.	*urge*	əːɹtʃ	tʃəː	əːɹtʃ	tʃəːɹ	əɹtʃ	tʃəː
177.	*Welsh*	welʃ	ʃel	wæuʃ	ʃæu	wæuʃ	ʃæu
178.	*whereabout*	weː.ɹə.bʌut	bʌu.tə.ɹəɹ.weː	weː.ɹə.bʌut	bʌu.təɹ.weː	weː.ɹə.bʌut	bʌu.ə.ə.weː
179.	*wolf*	wuːf	fuː	wuːf	fuː	wuːf	fuː
180.	*woodland*	wud.lən	læn.wud	wud.lən	lən.wuːd	wud.lən	lən.wuːd

VII. HK-M-20-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeid	fɹeid.æt	e.fɹeid	dɨː.fɹʌ.ei	e.fɹeːjd	fɹei.daː
2.	*age*	eiʤ	ʧjuː.eː	eiʧ	ʧjuː.ei	eitʃ	tʃuː.ei
3.	*Alps*	æps	siː.æp	æːps	sæːp	æːpts	siz.æːp
4.	*amuse*	ʌ.miːws	mjuː.es	e.miːws	mjuː.zʌ	ʌ.miː.us	mjuːz.aː
5.	*anguish*	æŋ.gwiʃ	gwiʃ.æn	æŋ.gwiʃ	gwiʃ.æn	æŋ.gweʃ	gwiʃ.æŋ
6.	*anklet*	æŋ.klekt	klikt.æn	æŋ.kɨ.lə	lʌk.æŋg	æŋ.klet	klət.æŋ
7.	*ant*	ænts	ten	ent	ten	eːnt	tsəː.en
8.	*approve*	e.pɹuːf	pɹu.vaɹ	e.pɹuːf	pɹuːf.aː	æ.pɹuːf	pɹuːv.aː
9.	*ask*	aːsk	kiː.siː.aːk	aːsk	kɨː.sɨː.aː	aːsk	kəː.sə.aː
10.	*asked*	aːskt	diː.ki.aː	aːsk	dɨː.kɨ.aː	aːskt	dəː.kə.aː
11.	*asks*	aːsk.s	si.aːsk	aːs	sɨː.aː	aːsk	kəː.sə.aː
12.	*bangs*	bæː.ŋis	siː.bæŋ	bæːŋks	siz.bæːŋk	bæːŋs	siz.bæŋg
13.	*begged*	bækt	dɨː.gə.bæ	bækt	dɨː.gə.bæ	bægd	dəː.gə.bæ
14.	*begs*	bæks	sɨz.be	bets	si.zɨ.bæ	beːt	siz.beːt
15.	*blast*	blaːst	tsi.si.blaː	blaist	tɨː.si.blei	bleist	tiː.si.blei
16.	*bled*	blæːd	læːb	blæːd	dæːb	blæːd	dəː.blæ
17.	*bloom*	buːm	um.ba	buːm	uːmb	bluːm	uːmb
18.	*blunt*	blaːnt	tsɨː.em.blan	blʌŋt	tʌŋ.plə	blʌŋt	tʌŋp
19.	*blur*	bəɹ	əɹb	bəɹ	əɹb	bləːɹ	əːɹp
20.	*brief*	bɹeif	fɹeip	bɹiːf	fɹiːp	bɹiːf	fɹeip
21.	*Britain*	bɹit.tən	tən.bɹit	bɹit.tən	tən.bɹit	bɹi.tən	tən.bɹe
22.	*bronze*	bɹɒns	si.bɹɒn	bɹɒns	sɨː.bɹɒn	bɹɒːnts	siz.bɹɒn

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biw	iː.uɹp	biːw	ɖjuːp	biud	dəː.biu
24.	*bulb*	bau	bau	bau	bau	baup	baup
25.	*bulbs*	bʌups	spʌuʔ	bʌups	siː.bʌu	baups	siz.bau
26.	*cashback*	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ	kæʃ.bæːk	bæk.kæʃ
27.	*clarify*	klæ.ɹi.fai	flai.ɹiʔ.kleː	klæ.ɹi.fai	flai.ɹi.kleː	klæ.ɹi.fai	fai.ɹi.keː
28.	*Clark*	klak	ɹak	klaːk	klaːk	klaːk	klaːk
29.	*clear*	kli.əɹ	əː.kliː	kli.əː	əː.kliː	kli.əːɹ	əː.kliː
30.	*cliff*	klif	flipk	klæf	flæpk	klif	fuː.klip
31.	*close*	klɐus	si.li.klɐu	klɐus	si.zi.klɐu	klʌus	siz.klʌu
32.	*closure*	klous.tʃə	ʃəː.klʌu	klous.ʤöː	sjöː.klʌu	klou.ʃəɹ	ʃəɹ.klʌu
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θeŋ	θiŋ.klʌu
34.	*clubbed*	klʌpt	dɨː.pi.klæp	klæpt	dɨː.bi.klæp	kaːpt	dəː.pi.kap
35.	*Constantine*	kɒn.stə.tiːn	tin.sti.kɒːn	kɒn.stən.tiːn	tin.sten.kɒːm	kɒn.stən.tiːn	tiːn.sten.kɒːn
36.	*corpse*	kɒps	si.zi.kɒp	kɒps	si.zi.kɒʔ	koːps	siz.kɒp
37.	*crawl*	kɹɒːl	ɹɒːw.kɑ	kɹɒːw	lɒːwŋ.kɹu	kɹɒːl	aː.ɹoːk
38.	*crisp*	kɹips	pɹipts	kɹips	pəː.se.kɹip	kɹæpsp	pəː.se.kɹæ
39.	*crow*	kɹou	oukɹ	kɹoːw	oːwkɹ	kɹoːw	ɹouk
40.	*crown*	kɹɒŋ	ɹaːŋk	kɹaːwŋ	ɹaːŋk	kɹaːwn	ɹaːŋk
41.	*cry*	kɹaːj	ɹaːjk	kɹaːj	aːjk	kɹaːj	aːjkɹ
42.	*cube*	kuːp	buː.ku	kuːp	bəː.kup	kuːb	buː.kuːb
43.	*digest*	dʌi.ʤest	ʤes.dai	dai.ʤest	ʤes.dai	dai.dʒeːs	dʒest.dai
44.	*disband*	dis.bæn	bæn.dis	dis.bæːnd	bæn.des	dis.bæːn	bæːn.dis
45.	*disclaim*	dis.kleim	kleim.dis	dis.klʌim	klein.dis	dis.klein	kleim.des

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.kʌs	kʌs.dis	dis.kʌs	kʌs.dis	dis.kʌs	gʌs.des
47.	*dumped*	dʌmpt	tiː.tʌm	dʌmpt	dəː.pe.dʌm	dʌmpt	dəː.pe.dʌm
48.	*east*	iːst	tsɨː.sɨ.iː	iːst	tsɨː.sɨ.iː	iːst	təː.sə.iː
49.	*eats*	iːts	siːt	iːts	səː.iː	iːts	səː.iːd
50.	*Ed*	æːd	dɨː.æ	æːd	dæːd	æːtʰ	dəː.æ
51.	*edge*	æʤ	tʃu.e	eʤ	tʃuː.e	ætʃ	tʃuː.æ
52.	*elf*	euf	fuː.eu	euf	fuː.eu	euf	fuː.eu
53.	*else*	eus	sɨː.eu	eus	siz.eu	eus	siz.eu
54.	*elves*	eufs	sɨː.fɨ.eu	eufs	sɨː.fɨ.eu	eu.fs	səː.fi.eu
55.	*encourage*	eŋ.kəː.ɹetʃ	ɹeitʃ.kəɹ.æn	eŋ.kəː.ɹeitʃ	ɹeitʃ.kəɹ.en	eŋ.kəː.ɹetʃ	ɹetʃ.kəɹ.æn
56.	*encouraging*	eŋ.kəː.ɹe.dʒiŋ	dʒiŋ.kəː.ɹed.æːn	eŋ.kəː.ɹed.ʤiŋ	dʒiŋ.ɹʌd.kəː.æːn	eŋ.kəː.ɹed.dʒiŋ	dʒiŋ.kəː.ɹʌd.æːn
57.	*English*	iŋ.leʃ	næʃ.iŋ	iŋ.leʃ	næʃ.iŋ	iŋ.leʃ	næʃ.eŋ
58.	*ex-con*	eks.kɒn	kɒn.eks	eks.kɒn	kɒj.neks	eks.kɒːn	kɒjn.eks
59.	*excuse*	eks.kiː.jus	kjuː.eːks	eks.kiː.ws	gjuː.eːks	eks.kiːws	skjuː.eks
60.	*exhale*	eks.hæw	hæw.eks	eks.hæw	hæw.eks	eks.hæw	hæw.eks
61.	*explode*	iks.plɐut	blɐut.eks	eks.pɐud	boud.eks	eks.plʌːwd	blʌud.eks
62.	*fabric*	fɹæ.bɹek	bɹek.fɹæk	feb.bɹeʔ	bɹik.fɹæʔ	fæt.bɹek	bɹik.fæ
63.	*fact*	fæk.ts	tsɨː.kɨ.fæ	fækt	tsɨː.kɨ.fæ	fækt	tsiz.kə.fæ
64.	*famed*	feːjmd	dɨː.fæm	feːjnd	dəː.fein	feːjmd	dəː.fein
65.	*fed*	fæːd	dæːf	fæd	dæf	fæːd	dæːf
66.	*film*	fiːm	iːmf	fiːm	iːmf	fiːm	iːmpf
67.	*fish*	feʃ	ʃuː.fit	feʃ	ʃuː.fit	feʃ	ʃuː.fit
68.	*flap*	flæp	plætf	flæp	plætf	flæp	plæf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flæpt	ɹæft	θəɹt	təɹθ	flə:t	tsəː.flaː
70.	*flu*	fə.luː	u:f.lɨ	fluː	u:f	fluː	u:fl
71.	*fly*	flai	a:jf	fla:j	a:jf	fla:j	a:jf
72.	*foolish*	fu.leʃ	l:ʃ.fuː	fu.leʃ	leʃ.fuː	fu.leʃ	leʃ.fuː
73.	*frank*	fɹæŋk	kɹæjmf	fɹæŋk	kɹæjmf	fɹæŋks	kəː.fɹæŋ
74.	*Franks*	fɹæŋks	sɨː.fɹæŋ	fɹæŋks	si.zɨ.kɨ.fɹæŋ	fɹæŋks	siz.ke.fɹæŋ
75.	*free*	fɹiː	i:ft	fɹiː	ɹi:f	fɹiː	ɹi:f
76.	*freshness*	flæʃ.nes	njʌs.flæʃ	flæʃ.nes	njʌs.flæʃ	flæʃ.ne:s	nʌs.flæʃ
77.	*friend*	fɹend	enfɹ	fɹend	dɨː.fɹen	fɹæ:nd	ɹæ:nf
78.	*fringe*	fɹintʃ	tɹuː.fin	fɹintʃ	tʃuː.fɹin	fɹentʃ	tʃjuː.fɹin
79.	*games*	geims	sɨz.geim	geims	siz.geim	ge:jms	siz.geiŋ
80.	*gasped*	ga:pst	dɨː.si.gap	gja:pst	dɨː.si.gæp	ga:pst	dəː.sə.gæ
81.	*gasps*	gæps.s	sɨs.gaʔ	ga:p.sɨ.sɨ	sɨ.sɨ.ga:p	ga:ps.s	səː.siz.gap
82.	*gave*	geif	fuː.gei	geif	fuː.gei	geif	fuː.gei
83.	*glue*	gluː	lu:g	gluː	u:g	gluː	u:gl
84.	*grab*	gɹæp	bɹæpk	gɹæp	bɹæpk	gɹæ:p	bɹæ:pk
85.	*grant*	gɹænts	tsɨː.gɹæn	gɹa:nt	tɹa:ŋk	gɹa:nt	tsəː.gɹa:n
86.	*grape*	gɹæp	ɹæpk	gɹeip	pɨː.gɹei	gɹæ:p	pəː.gɹæb
87.	*help*	hæup	puː.heu	hæup	pæu	hʌup	pəː.heu
88.	*helped*	hæupt	dɨ.hæu	hæupt	dəː.pɨ.hew	haupt	dəː.pi.heup
89.	*hobnob*	hup.nə:p	nə:p.hə:p	hup.nə:p	nəp.hʌp	hə:p.nə:b	nə:p.hə:b
90.	*implore*	im.bloɹ	glɒː.en	im.ploə	ploə.in	im.ploəɹ	əː.plɒ.in
91.	*improve*	in.pɹu:f	pɹu:f.en	im.pɹu:f	pɹu:f.en	im.pɹu:f	pɹə:f.em

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃju:.in	intʃ	tʃju:.in	intʃ	tʃu:.in
93.	*increasing*	iŋ.kɹi:.se:ŋ	siŋ.kɹi:.i:n	iŋ.kɹi:.se:ŋ	seŋ.kɹi:.i:ŋ	iŋ.kɹi:.se:ŋ	seŋ.kɹi:.in
94.	*indefinite*	in.dæ.fi.net	ne.fæ.də.in	in.di:.fæ.net	nʌs.fæn.di:.im	in.di:.fæ.net	nʌt.fæn.di:.i:m
95.	*independent*	in.di:.pen.dʌn	dʌm.pen.di:.in	in.di:.pen.dən	dʌm.pen.di:.in	in.di:.pen.dʌn	dʌm.pen.di:.in
96.	*inflict*	in.flekt	flekt.in	in.flækt	tə:.kɨ.flæ.in	in.flek	flekt.in
97.	*infuse*	in.fju:s	fju:.sin	in.fju:s	fju:.sin	in.fju:s	fju:s.in
98.	*ink*	iŋk	k.kiŋk	iŋk	kiŋ	iŋk	kiŋ
99.	*inked*	iŋkt	də:.kɨ.iŋ	iŋkt	də:.kə.ʔiŋ	iŋkt	də:.kə.iŋ
100.	*inks*	iŋ.ks	sə.iŋk	iŋ.ks	sɨ:.kə.iŋ	iŋ.ks	sə:.kə.iŋ
101.	*instinct*	in.stiŋkt	tɨ:.stiŋ.in	in.ste:ŋkt	ste:ŋkt.in	in.ste:ŋt	ste:ŋkt.in
102.	*instrument*	ins.tɹu.men	men.stɹʌ.in	in.stɹə.men	men.stɹʌ.in	in.stɹə.men	men.stɹʌ.in
103.	*i-Tunes*	ai.tu:ns	tjuns.ai	ai.ty:ns	tjuns.ai	ai.ty:ns	tjuns.a:j
104.	*jasmine*	dʒæs.mi:n	mi:n.dʒæs	dʒæs.men	mʌn.dʒæs	dʒæs.men	mæn.jes
105.	*jumps*	dʒʌms	sʌmdʒ	dʒʌmps	sɨ:.dʒʌm	dʒʌmps	siz.dʒʌm
106.	*kept*	kæpt	tsɨ:.pɨ.kæp	kæpt	tsɨ:.pi.kæp	kept	tsə:.kæp
107.	*lapse*	læps	sɨ.læp	læps	sɨ:.læp	læps	sə:.lap
108.	*lapsed*	læpst	tɨ:.sɨ.læ	læpst	dɨ:.sɨ.læ	læpst	də:.si.læ
109.	*larks*	la:ks	sɨ:.kə.la:	la:ks	sa:k	la:ks	siz.kə.la:
110.	*lend*	læn	dæn	lænd	dænd	læ:nd	dæ:n
111.	*lift*	lift	tsi.lif	lift	tə:.fɨ.lip	left	tsə:.fʌ.lip
112.	*lisp*	lepsp	pleps	lipsp	pə:.sə.lip	lepsp	pə:.si.lip
113.	*lived*	lift	tɨ:.fi.lə:t	li:ft	də:.fə.lip	left	də:.si.lip
114.	*lives*	la:jfs	sa:jf	laifts	sɨ:.fɨ.lai	laifs	siz.laif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lɒg	klɒ	lɒg	ɒ	lɒk	klɒʔ
116.	*log*	lɒk	glɒː	lɒː	ɒː	lɒʔ	ɒʔ
117.	*lump*	lʌm	klʌm	lɐmp	plɐm	lʌmp	plʌm
118.	*matched*	mætʃt	det.ʃu.mæ	mætʃt	dəː.tʃu.mæ	mætʃt	dəː.tʃu.mæ
119.	*melt*	mewts	tsɨː.mew	mewts	tsɨː.mew	meuts	tsəː.meu
120.	*milk*	mjuːk	kjuː	mjuːk	kəː.mjuː	mjuːk	kəː.mjuː
121.	*misquote*	mis.kʌut	təː.ko.mis	mis.kʌut	kɐut.mis	mis.kʌuts	kou.mis
122.	*ounce*	ɒːwns	sɨ.zɨ.õ	ɒns	sɨ.zɨ.ɒn	auŋs	siz.auŋ
123.	*owns*	oːŋs	siz.ʌuŋ	oːŋs	sʌːwŋ	ouŋs	siz.ʌuŋ
124.	*ox*	ɒks	sɨː.ɒ	ɒks	sɒʔ	ɒks	sɒʔ
125.	*participate*	pe.ti.sə.peit	pei.si.tip.taː	pe.ti.sə.pei	pei.ti.sip.taː	pe.ti.sə.pei	pei.si.tə.paː
126.	*peacemaking*	piːs.me.keŋ	kiŋ.meks.piː	piːs.meː.kiŋ	keːŋ.mek.piːs	piːs.me.keːŋ	keːŋ.mek.piːs
127.	*play*	pleːj	eːjp	pleːj	eːjp	pleːj	eːjp
128.	*pray*	pɹei	eːjp	pɹeːj	ɹeːjp	pɹeːj	ɹeːjp
129.	*presidency*	pɹæ.si.dʌn.siː	siː.dən.se.pɹæː	pɹæ.si.dən.siː	siː.dən.se.pɹæː	pɹæ.si.dən.siː	siː.dən.si.pɹeː
130.	*puffs*	pʌːfs	sʌːp	pʌfs	sɨː.fɨv.pʌp	pʌfs	siz.pʌf
131.	*raised*	ɹeist	tɨː.sɨ.ɹei	ɹeist	tɨː.si.ɹei	ɹeːjst	dəː.se.ɹei
132.	*range*	ɹeintʃ	tʃu.ɹeːŋ	ɹeintʃ	tʃuː.ɹeŋ	ɹeːŋtʃ	tʃuː.ɹeːŋ
133.	*recommend*	ɹe.kə.mæːn	meːŋ.kəm.ɹæːʔ	ɹe.kə.mæːnd	mæŋ.kəm.ɹæːʔ	ɹe.kə.mæːn	meːŋ.kəm.ɹæːʔ
134.	*recruiter*	ɹiː.kɹu.taː	tæ.kud.ɹiː	ɹiː.kɹu.taː	tæ.kɹud.ɹiː	ɹiː.kɹu.taɹ	təː.kud.ɹei
135.	*refrigerator*	ɹi.fæ.dʒu.ɹei.ðəɹ	təː.ɹi.dʒæ.fe.ɹiː	ɹiː.fæ.dʒu.ɹei.təɹ	təː.ɹeː.dʒe.fæd.ɹiː	ɹiː.fæ.dʒu.ɹei.təː	təː.ɹei.dʒə.fæ.ɹiː
136.	*relationship*	ɹiː.lei.ʃʌn.ʃeːp	sip.ʃʌn.nei.ɹiː	ɹiː.lei.ʃʌn.ʃip	sip.ʃʌn.lei.ɹiː	ɹiː.lei.ʃʌn.ʃeːp	ʃip.ʃʌn.lʌi.ɹiː
137.	*representative*	ɹæ.pɹi.sæn.tə.tif	tif.ti.sæn.pɹi.ɹæ	ɹæ.pɹi.sæn.tə.tif	tif.tid.sæm.pɹiː.ɹe	ɹe.pi.zæn.tə.tif	tif.tiː.sem.pɹiː.ɹeʔ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	dəː.ɹʌʃ	ɹʌʃt	dəː.ʃə.ɹʌt	ɹʌʃt	dəː.ʃə.ɹʌt
139.	*scratch*	skɹætʃ	tʃju:.skɹæ	skɹætʃ	tʃju:.skɹæ	skɹætʃ	tʃuː.skɹæ
140.	*scree*	skɹiː	ɹiː.zə	skɹiː	ɹiːs	skɹiː	ɹiːsk
141.	*segment*	sæk.min	mʌn.sæk	sæk.min	men.sæk	sæg.men	men.sæːg
142.	*senseless*	sens.nəːs	nʌs.sens	sens.nəːs	nʌs.sens	sens.lʌs	lʌs.sens
143.	*sequence*	siː.kwens	si.zi.kwʌn.siː	siː.kwens	sjəː.kwʌn.siː	siː.kwens	siː.kwens
144.	*shameless*	ʃeim.nes	nʌs.ʃein	ʃei.nes	nʌs.ʃein	ʃeim.nes	nʌs.ʃein
145.	*shelve*	ʃauf	fuː.ʃau	ʃauf	fuː.ʃau	ʃʌuf	fuː.ʃau
146.	*shelved*	ʃauft	dɨː.fɨ.ʃau	ʃauft	dɨː.fi.ʃau	ʃeuft	dəː.fi.ʃau
147.	*skate*	skeits	tsɨː.skeit	skeidz	tsɨː.skei	skeit	tsəː.skei
148.	*skating*	skei.tiŋ	tiŋ.skei	skei.ɹiŋ	tiŋ.skei	skei.teŋ	tiŋ.skei
149.	*slope*	sləp	pəː.sləp	sləːp	pəː.sləp	sləːp	pəː.sləp
150.	*small*	smoː	lɒːs	smɒː	mɒːs	smɒː	mɒːs
151.	*smooth*	smuːf	fuːs	smuːf	muːfs	smuːf	muːfs
152.	*snatch*	snætʃ	tʃuːs.næk	snætʃ	tʃuːs.næk	snætʃ	tʃuː.snæ
153.	*spa*	spaː	aːsp	spaː	aːsp	spaː	aːsp
154.	*spare*	speː.əː	əːs.beː	speː.əɹ	əɹs.pæː	speː.eɹ	əːs.bæː
155.	*sphere*	sfi.aː	əːs.fiː	sfi.əː	əːs.fiː	sfiː.əː	əː.sfiː
156.	*spiritual*	spi.ɹi.tʃɐu	tʃoː.ɹi.spiː	spiː.ɹi.tʃɐu	tʃoː.ɹi.spiː	spiː.ɹi.tʃau	tʃoː.ɹi.spiː
157.	*splendid*	splen.diːd	di.splen	splæn.ded	di.splæn	splæn.did	di.splæn
158.	*split*	spliːt	liːs.pliːt	split	tsɨː.split	splet	tsəː.splet
159.	*spoil*	spɒ.jou	ou.spɒy	spɒ.jol	ou.spɒj	spɒ.jʌu	ou.spɒj
160.	*spray*	spɹeːj	ɹeːjsp	spɹeːj	ɹeːjsp	spɹeːj	ɹeːjsp

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹæː.ŋə	ɹeːŋsp	spɹeːŋ	ɹeːŋsp	spɹeːŋ	ɹeːŋsp
162.	*springs*	spɹeːŋs	sɨː.spɹeiŋ	spɹeːŋs	sɨː.spɹeŋ	spɹeːŋs	səː.si.bɹeŋ
163.	*squeeze*	skwiːs	siː.skwiː	skwiːz	siː.skwiː	skwiːs	siː.skwiː
164.	*stain*	stæn	næns	steːŋ	ɹeːŋst	steːŋ	eːŋst
165.	*star*	staɹ	aɹst	staɹ	aɹst	staɹ	aɹst
166.	*string*	stɹiŋ	ɹiŋst	stɹeːŋ	ɹeŋst	stɹeːŋ	ɹeː.ŋist
167.	*stupid*	stjuː.ped	pe.stiːw	stjuː.ped	ped.stiːw	stjuː.ped	ped.stjuː
168.	*suppose*	sʌ.pʌus	pʌu.sæp	sʌ.pʌus	sɨː.pʌu.sap	sʌ.pʌus	pʌus.sap
169.	*swim*	swiːm	miːms	swim	wims	swin	wimps
170.	*text*	tekst	tɨː.si.teʔ	tekst	tɨː.si.teʔ	tekst	təː.si.teʔ
171.	*thankful*	θeŋk.fɐu	fɐud.θeŋ	θeŋk.fɐu	fɐu.θæŋ	θeŋk.fʌu	fou.θeːŋ
172.	*trenched*	tɹænʃt	dɨː.tʃu.tɹæn	tɹenʃt	dɨː.tʃu.tɹæn	tɹentʃt	dəː.ʃu.tɹen
173.	*tweet*	twiːts	tiː.wets	twiːts	twiːts	twiːts	twiːts
174.	*underpaid*	ön.də.peid	d.pei.də.ʌn	ʌn.də.pei	peid.də.an	ʌn.də.pei	pei.də.ʌn
175.	*understand*	ʌn.dəɹ.stæn	steːn.dəɹ.ʌn	ʌn.dəɹ.steːn	steːn.dəɹ.ʌn	ʌn.dəɹ.steːn	stæn.dəɹ.ʌn
176.	*urge*	əɹtʃ	tʃjyː.əɹ	əɹtʃ	tʃjyː.əɹ	əːɹtʃ	ʃuː.aɹ
177.	*Welsh*	weuʃ	ʃɨː.weu	weuʃ	ʃɨ.lju.weu	weuʃ	ʃuː.weu
178.	*whereabout*	weː.ɹə.baut	bau.ɹə.weː	weː.ɹə.bɐu	bʌu.ɹət.weː	weː.ɹə.bauʔ	bʌu.ɹəd.weː
179.	*wolf*	woːf	fuː.ɹaː	wəːf	fuː.wə	wuːf	fuːp
180.	*woodland*	wud.læn	læn.wuːd	wud.læn	læn.wuːd	wud.læn	læn.wəːd

VIII. HK-M-21-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	ɹei.ʌf	ə.fɹeit	fɹeit.a	ə.fɹeit	fɹeit.a
2.	*age*	eitʃ	dʒei	eitʃ	dʒei	eidʒ	dʒei
3.	*Alps*	ælps	sælp	ælps	psæl	ælps	sælp
4.	*amuse*	ə.mjuːs	mjus.ə	ə.mjuːs	mjus.ʌ	ʌ.mjuːs	mjus.ʌ
5.	*anguish*	eŋ.gwiʃ	gwiʃ.æŋ	eŋ.gwiʃ	gwiʃ.eŋ	eŋ.gwiʃ	gwiʃ.eŋ
6.	*anklet*	eŋk.klet	let.eŋk	eŋk.let	let.eŋk	eŋk.let	let.eŋk
7.	*ant*	ænt	tæn	ænt	tæn	ænt	tæn
8.	*approve*	ə.pɹuːf	pɹuf.æp	ʌ.pɹuːf	pɹuf.ʌp	ə.pɹuːf	pɹuf.ʌ
9.	*ask*	aːsk	kaːs	aːsk	kaːs	aːsk	kaːs
10.	*asked*	aːst	taːs	askt	ts.aːs	askt	t.ask
11.	*asks*	ʌsks	ks.ʌs	aːsks	ks.as	aːsks	ks.aːs
12.	*bangs*	bæŋs	sbæŋg	bæŋs	sbæŋk	bæŋs	sbæŋk
13.	*begged*	begd	ktbek	bekt	tbek	bekt	tbek
14.	*begs*	beks	sbek	beks	sbek	beks	sbek
15.	*blast*	blast	asp	blast	tsblas	blast	tblas
16.	*bled*	blet	et.blə	blet	et.blə	blet	dbleː
17.	*bloom*	bluːm	luːmp	bluːm	luːmp	bluːm	luːmp
18.	*blunt*	blənt	əntp	blʌnts	tsblʌn	blʌnt	tblʌn
19.	*blur*	bləː	ləːp	bləː	ləːp	bləː	ləːp
20.	*brief*	bɹiːf	fiːp	bɹiːf	fbɹiː	bɹiːf	fbɹiː
21.	*Britain*	bɹi.ʔən	ʔən.bɹi	bɹi.ən	ən.bɹi	bɹi.ən	ən.bɹi
22.	*bronze*	bɹns	sbɹɒn	bɹons	ɹonsp	bɹons	ɹonsp

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	dbiu	biut	dbiu	biut	dbiu
24.	*bulb*	bʌub	bbʌu	bʌub	ʌub	bʌub	ʌub
25.	*bulbs*	bʌups	psbʌu	bʌups	sbʌup	bʌups	psbʌu
26.	*cashback*	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ
27.	*clarify*	kle.ɹi.fai	fai.ɹi.kle	kle.ɹi.fai	fai.ɹi.kle	klæ.ɹi.fai	fai.ɹi.klæ
28.	*Clark*	kla:k	a:kl	kla:k	a:kl	klak	lak
29.	*clear*	kliə	liək	kliə	liək	kliə	liək
30.	*cliff*	klif	lifk	klif	lifk	klif	lifk
31.	*close*	klous	lousk	klous	lousk	klous	lousk
32.	*closure*	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou
34.	*clubbed*	klʌpt	tklʌp	klʌpt	tklʌp	klʌpt	tklʌb
35.	*Constantine*	kon.sten.ti:n	tin.sten.ko:n	kon.sten.tin	tin.sten.kon	kon.sten.tin	tin.sten.kon
36.	*corpse*	kops	pskoː	kops	opsk	koːps	pskoː
37.	*crawl*	kɹoːl	loukɹ	kɹau	ɹauk	kɹoːl	ɹoːlk
38.	*crisp*	kɹisp	spkɹi	kɹisp	pkɹis	kɹisp	pkɹis
39.	*crow*	kɹau	ɹauk	kɹau	ɹauk	kɹau	ɹauk
40.	*crown*	kɹʌun	ʌunkɹ	kɹa:n	ɹa:ŋk	kɹaun	ɹauŋk
41.	*cry*	kɹai	ɹaik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kjuːp	bkjuː	kjup	juːpk	kjup	bkjuː
43.	*digest*	dai.dʒest	dʒes.dai	dʌi.dʒest	dʒest.dʌi	dʌi.dʒest	dʒes.dʌi
44.	*disband*	dis.bænt	bæn.dis	dis.bent	bent.dis	dis.bent	bent.dis
45.	*disclaim*	dis.kleim	kleim.dis	dis.kleim	kleim.dis	dis.kleim	kleim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.kʌs	kʌs.dis	dis.kʌs	kʌs.dis	dis.gʌs	kʌs.dis
47.	*dumped*	dʌmpt	t.dum	dʌmpt	tdump	dʌmpt	tdump
48.	*east*	i:st	tiːs	i:st	stiː	i:st	tiːs
49.	*eats*	i:ts	ts.iː	its	sit	its	sit
50.	*Ed*	et	de	et	de	et	deː
51.	*edge*	etʃ	dʒi.et	etʃ	dʒet	etʃ	dʒeː
52.	*elf*	elf	fel	elf	fel	elf	fel
53.	*else*	els	sel	els	sel	els	sel
54.	*elves*	elfs	fs.el	elvs	selv	elvs	selv
55.	*encourage*	iŋ.kə.ɹitʃ	ɹitʃ.kə.iŋ	in.kə.ɹeitʃ	ɹeitʃ.kə.in	in.kə.ɹeitʃ	ɹeitʃ.kə.in
56.	*encouraging*	iŋ.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	iŋ.kə.ɹi.dʒiŋ	dʒiŋ.ɹei.kə.in	iŋ.kə.ɹi.dʒiŋ	dʒiŋ.ɹei.kə.in
57.	*English*	iŋg.liʃ	liʃ.iŋ	iŋg.liʃ	gliʃ.iŋ	iŋg.liʃ	gli.ʃiŋ
58.	*ex-con*	iks.kən	kən.iks	iks.kən	kən.iks	iks.kən	kən.iks
59.	*excuse*	iks.kjuːs	kius.iks	iks.gjuːs	kjus.iks	iks.gjuːs	kjus.iks
60.	*exhale*	ik.sel	hel.iks	iks.hel	hel.eks	ik.sel	hel.iks
61.	*explode*	iks.plout	plout.iks	iks.plout	plout.iks	iks.plout	plout.iks
62.	*fabric*	fe.bɹik	bɹik.feː	fe.bɹik	bɹik.feː	fæ.bɹik	bɹik.feː
63.	*fact*	fækt	tfæk	fækt	æktf	fækt	tfæk
64.	*famed*	feimt	eimtf	feimt	tfeim	feimt	tfeim
65.	*fed*	fet	etf	fet	etf	fet	etf
66.	*film*	film	əm.fiː	film	yn.fi	film	imf
67.	*fish*	fiʃ	ʃfiː	fiʃ	ʃfiː	fiʃ	ʃfiː
68.	*flap*	flep	lepf	flep	lepf	flep	lepf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flət	ətfl	flət	ətfl̋	flət	lətf
70.	*flu*	fluː	uːf	fluː	luːf	fluː	luːf
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	liʃ.fu	fu.liʃ	liʃ.fu	fu.liʃ	liʃ.fu
73.	*frank*	fɹæŋk	ɹæŋkf	fɹeŋk	ɹeŋkf	fɹeŋk	ɹeŋkf
74.	*Franks*	fɹeŋks	sfɹeŋk	fɹeŋks	sfɹeŋk	fɹeŋks	sfɹeŋk
75.	*free*	fɹiː	ɹiːf	fɹiː	ɹiːf	fɹiː	ɹif
76.	*freshness*	fɹeʃ.nis	nəs.fɹeʃ	fɹeʃ.nis	nis.fɹeʃ	fɹeʃ.nis	nəs.fɹeʃ
77.	*friend*	fɹent	en.fɹi	fɹend	ɹentf	fɹent	ɹentf
78.	*fringe*	fɹintʃ	tʃfɹin	fɹintʃ	ɹintʃf	fɹintʃ	tʃfɹin
79.	*games*	geims	sgeim	geːms	sgeːm	geːms	sgeːm
80.	*gasped*	gespt	pt.ges	gespt	tgeps	gespt	tgesp
81.	*gasps*	gesps	psges	gesps	psges	gesps	psges
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	gluː	luːk	gluː	luːg	gluː	luːk
84.	*grab*	gɹep	pgɹe	gɹep	pgɹeː	gɹep	bge
85.	*grant*	gɹent	t.gɹen	gɹʌnt	entgɹ	gɹænt	tgɹæn
86.	*grape*	gɹeip	pgɹei	gɹeip	pgɹei	gɹeip	pgɹei
87.	*help*	help	pel	help	pel	help	pel
88.	*helped*	helpt	pthel	helpt	thel	helpt	thelp
89.	*hobnob*	hop.nop	nop.hop	hop.nop	nob.hop	hop.nop	nop.hop
90.	*implore*	im.ploə	plo.im	im.ploə	ploə.im	im.ploə	ploə.im
91.	*improve*	im.pɹuːf	pɹuf.in	im.pruːf	pɹu.vin	im.pɹuːf	pɹuf.in

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fi.nit	net.fi.de.in	in.de.fi.nit	nət.fi.de.in	in.de.fi.nit	nət.fi.de.in
95.	*independent*	in.di.pen.dənt	dən.spen.di.in	in.di.pen.dənt	dənt.pen.di.in	in.di.pen.dənt	dənt.pen.di.in
96.	*inflict*	in.flet	flet.in	in.flekt	flekt.in	in.flekt	flekt.in
97.	*infuse*	in.fjus	fjus.in	in.fjuːs	fju.sin	in.fjuːs	fjus.in
98.	*ink*	iŋk	ŋ.ni	iŋk	kiŋ	iŋk	kiŋ
99.	*inked*	iŋkt	kt.iŋ	iŋkt	tiŋk	iŋkt	t.iŋk
100.	*inks*	iŋks	skiː	iŋks	siŋk	iŋks	siŋk
101.	*instinct*	in.sdiŋt	stiŋt.in	in.sdiŋt	sdiŋt.in	in.sdiŋt	sdiŋt.in
102.	*instrument*	in.sɹə.mənt	mən.stɹən.in	in.ʃəm.mənt	mənt.ʃəm.in	in.ʃəm.mənt	mən.stɹəm.in
103.	*i-Tunes*	ʌi.tuns	tuns.ʌi	ʌi.tjuns	tyns.ʌi	ʌi.tjuns	tjun.sʌi
104.	*jasmine*	dʒes.min	min.dʒes	dʒes.min	min.dʒes	dʒes.min	min.dʒes
105.	*jumps*	dʒʌmps	psdʒʌm	dʒʌmps	sdʒʌmp	dʒʌmps	psdʒʌm
106.	*kept*	kept	eptk	kept	tkep	kept	tkep
107.	*lapse*	leps	slep	leps	slep	leps	psleː
108.	*lapsed*	lepst	stlep	lepst	tleps	lepst	tslep
109.	*larks*	laːks	slaːk	laks	slak	laks	slak
110.	*lend*	lend	dlen	lent	dlen	lent	dlen
111.	*lift*	lift	ftliː	lift	tlif	lift	tlif
112.	*lisp*	lisp	spliː	lisp	spliː	lisp	pliːs
113.	*lived*	livd	fliː	livd	dlif	livd	dlif
114.	*lives*	laifs	slaiv	laivs	slaiv	laifs	slaif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	klo	lok	klok	lok	klok
116.	*log*	log	glo	log	glo	lo:g	glo:
117.	*lump*	lʌmp	plʌm	lʌmp	plʌm	lʌmp	plʌm
118.	*matched*	metʃt	tʃtme	metʃt	tʃtme:	metʃt	tmetʃ
119.	*melt*	melt	tc̡mel	melt	tmel	melt	tmel
120.	*milk*	miuk	kmiu	miuk	kmiu	miuk	kmiu
121.	*misquote*	mis.kwout	kwout.mis	mis.kwout	kwout.mis	mis.kwout	kwout.mis
122.	*ounce*	auns	s.aun	auns	saun	auns	saun
123.	*owns*	o:ns	so:n	o:ns	so:n	ons	son
124.	*ox*	ɒ:ks	sɒ:	ɒks	sɒ:	oks	sok
125.	*participate*	pʌ.ti.ci.peit	pei.ci.ti.pʌ	pa.ti.si.peit	peit.si.ti.pa	pʌ.ti.sɯ.peit	peit.si.ti.pʌ
126.	*peacemaking*	pis.mek.kiŋ	kiŋ.mek.pis	pis.mei.kiŋ	kiŋ.mei.pis	pis.mei.kiŋ	kiŋ.mə.pis
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.den.si	si.den.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	spʌf	pʌfs	spʌf	pʌfs	spʌf
131.	*raised*	ɹeist	tʃ.ɹeis	ɹeist	tsɹes	ɹeist	tɹeis
132.	*range*	ɹeintʃ	tʃ.ɹein	ɹeintʃ	dɹein	ɹeintʃ	dɹein
133.	*recommend*	ɹe.kəm.ment	men.kəm.ɹe	ɹe.kəm.ment	men.kən.ɹe	ɹe.kəm.ment	men.kən.ɹe
134.	*recruiter*	ɹi.kɹi.tə	tə.kɹi.ɹi	ɹi.kɹi.tʌ	tə.kɹi.ɹi	ɹi.kɹi.tʌ	tʌ.kɹi.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹi.dʒə.fɹi.ɹi	ɹi.fɹi.dʒi.ɹei.tʌ	tə.ɹei.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.ti.tif	tif.tə.sen.pɹi.ɹi	ɹe.pɹi.sen.ti.tif	tif.tei.sen.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	tif.tei.sen.pɹi.ɹe

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	tʃɹʌʃ	ɹʌʃt	tɹʌʃ	ɹʌʃt	tɹʌʃ
139.	*scratch*	skɹetʃ	tʃskɹe	skɹetʃ	kɹetʃs	sgɹetʃ	tʃsgɹe
140.	*scree*	skɹiː	ɹisk	skɹiː	kɹiːs	skɹiː	kɹiːs
141.	*segment*	seg.mənt	mənt.sek	seg.mənt	mən.sek	seg.mənt	mənt.sek
142.	*senseless*	sens.les	les.sens	sens.les	les.sens	sens.les	les.sens
143.	*sequence*	si.kwəns	kwənts.siː	si.kwəns	kwəns.siː	si.kwəns	kwəns.siː
144.	*shameless*	ʃem.les	les.ʃem	ʃeim.les	les.ʃeim	ʃeim.les	les.ʃeim
145.	*shelve*	ʃelf	fʃel	ʃelv	elfʃ	ʃelf	vʃel
146.	*shelved*	ʃelft	elftʃ	ʃelft	dʃelf	ʃelft	tʃelf
147.	*skate*	skeit	keits	sgeit	eisk	sgeit	eisk
148.	*skating*	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei
149.	*slope*	sloup	loups	sloup	loups	sloup	loups
150.	*small*	smoːl	moːls	smoːl	moːls	smoːl	moːls
151.	*smooth*	smuːθ	θsmuː	smuːθ	muːθs	smuːθ	θsmuː
152.	*snatch*	snetʃ	tʃ.nes	snetʃ	netʃs	snetʃ	tʃsne
153.	*spa*	spʌ	asp	spaː	paːs	spaː	paːs
154.	*spare*	speə	peəs	speə	eəsp	speə	peəs
155.	*sphere*	sfiə	fiəs	sfiə	fiəs	sfiə	fiəs
156.	*spiritual*	sbi.ɹi.tʃuəl	tʃuəl.ɹi.sbi	sbi.ɹi.tʃəl	tʃəl.ɹi.sbi	sbi.ɹi.tʃəl	tʃəl.ɹi.sbi
157.	*splendid*	splen.dit	dit.splen	sblen.dit	dits.blen	sblen.dit	dits.blen
158.	*split*	sblits	litsp	sblits	plits	sblits	plits
159.	*spoil*	sboil	oilsp	sboil	oilsp	sboil	oilsp
160.	*spray*	sbɹei	ɹeisp	sbɹei	ɹeisp	sbɹei	pɹes

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	ɹiŋsp	spɹiŋ	pɹiŋs	sbɹiŋ	ɹiŋsp
162.	*springs*	sbɹiŋs	ɹiŋsp	sbɹiŋs	ɹiŋsp	sbɹiŋs	sbɹiŋ
163.	*squeeze*	skwiːs	isk^{w}	sgwiːs	iːsk	skwiːs	ɹisk
164.	*stain*	sdein	einst	sdein	einst	sdein	einst
165.	*star*	staː	aːst	staː	aːst	sdaː	aːst
166.	*string*	sdɹiŋ	ɹiŋst	sdɹiŋ	ɹiŋst	sdɹiŋ	ɹiŋst
167.	*stupid*	stju.pit	pit.stjuː	stju.pət	pəts.djuː	stju.pit	pits.djuː
168.	*suppose*	sə.pous	pou.səp	sə.pous	pou.sʌp	səp.pous	pou.sʌp
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tekst	tsteks	tekst	tsteks	tekst	tsteks
171.	*thankful*	θæŋk.fəu	fəu.θæŋk	θeŋk.fəu	fəu.θeŋk	θeŋk.fəu	fəu.θeŋk
172.	*trenched*	tɹentʃt	tʃtʃen	tɹentʃt	ttɹentʃ	tɹentʃt	ttɹentʃ
173.	*tweet*	twit	tiut	twit	wit	twit	wit
174.	*underpaid*	ʌn.də.peit	pei.də.ʌn	ən.də.peit	pei.dʌ.ʌn	ən.də.peit	pei.də.ʌn
175.	*understand*	ʌn.də.sten	sten.də.ʌn	ʌn.də.sden	sden.də.ʌn	ʌn.də.sdent	sden.də.ʌn
176.	*urge*	əːɹtʃ	tʃ.əːɹ	əːtʃ	dʒəː	əːtʃ	dʒəː
177.	*Welsh*	wolʃ	ʃwol	wolʃ	ʃwol	wolʃ	ʃwol
178.	*whereabout*	weə.ə.bʌut	bʌut.ə.we	we.ɹə.bʌut	bʌut.ɹʌ.ɹe	we.ɹə.bʌut	bʌu.tʌ.we
179.	*wolf*	wuːf	f.wuː	wuːf	f.wuː	wuːf	f.wuː
180.	*woodland*	wut.lent	lent.wud	wut.lent	lend.wut	wut.lent	lent.wut

IX. HK-M-22-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit^{h}	fɹei.dʌ	ə.fɹeit^{h}	fɹei.də	ə.fɹeit^{h}	fɹei.də
2.	*age*	eitʃ	dʒei	eitʃ	dʒei	eitʃ	dʒei
3.	*Alps*	ælps	sælp	ælps	sælp	ælps	sælp
4.	*amuse*	ə.mius	mius.zʌː	ə.mjuːs	miu.zəː	ə.mjuːs	mju.zəː
5.	*anguish*	æŋ.gwiʃ	gwiʃ.æŋ	æŋ.gwiʃ	gwiʃ.æŋ	æŋ.gwiʃ	gwiʃ.æŋ
6.	*anklet*	æŋ.klə	klə.æn	æŋ.klə	klə.æŋ	æŋ.klə	klə.æŋ
7.	*ant*	ænt	tæn	ænt	ænt	ant	tan
8.	*approve*	ə.pɹuːf	pɹu.vʌ	ʌ.pɹuːf	pɹu.vʌ	ə.pɹuːf	pɹu.və
9.	*ask*	aːsk	kaːs	aːsk	kaːs	aːsk	kaːs
10.	*asked*	aːskt	taːsk	aːskt	taːsk	aːskt	taːsk
11.	*asks*	aːsks	skaː	aːsks	saːsk	aːsks	saːsk
12.	*bangs*	bæŋs	sbæŋ	bæŋs	sbæŋ	bæŋs	sbæŋs
13.	*begged*	bek^{h}t^{h}	ktbe	bek^{h}t^{h}	tbe	bek^{h}t^{h}	təm.bek
14.	*begs*	bek^{h}s	sbe	bek^{h}s	sbek	bek^{h}s	sbek
15.	*blast*	blaːst	laːs.bə	blaːst	tblaːs	blaːst	tblaːs
16.	*bled*	blet^{h}	let.bə	blet^{h}	tble	blet^{h}	tble
17.	*bloom*	blum	mə.blun	blum	mump	blum	muːp
18.	*blunt*	blʌnt	lʌnt.bə	blʌnt	tblʌn	blʌnt	tblʌn
19.	*blur*	bləː	ləːp	bləː	ləːp	bləː	ləːp
20.	*brief*	bɹif	fɹib	bɹif	fɹbi	bɹif	fɹbi
21.	*Britain*	bɹi.ʔən	əm.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi
22.	*bronze*	bɹons	zbɹon	bɹonz	zbɹon	bɹons	zbɹon

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	bilt^{h}	ilp	bilt^{h}	tbil	bilt^{h}	tə.bil
24.	*bulb*	bʌlp^{h}	blʌlb	bʌlp^{h}	blʌp	bʌlp^{h}	bʌl
25.	*bulbs*	bʌlps	psbʌl	bʌlps	sbʌlp	bʌlps	sbʌlp
26.	*cashback*	bæʃ.bæk	bæ.kæʃ	bæʃ.bæk	bæk.kæʃ	bæʃ.bæk	bæk.kæʃ
27.	*clarify*	klæ.ɹi.fai	fai.ɹi.klæ	klæ.ɹi.fai	fai.ɹi.klæ	klæ.ɹi.fai	fai.ɹi.kle
28.	*Clark*	kak	kauk	klak	kla	klak	klaː
29.	*clear*	kleə	ə.kli	kleə	ə.kli	kliə	ə.kli
30.	*cliff*	kliːf	fkliː	klif	lifk	klif	lifk
31.	*close*	klous	sklou	klous	lousk	klous	lousk
32.	*closure*	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou
33.	*clothing*	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou	klou.θiŋ	θiŋ.klou
34.	*clubbed*	$\text{klʌp}^{h}\text{t}^{h}$	tlʌp	$\text{klʌp}^{h}\text{t}^{h}$	tklʌp	$\text{klʌp}^{h}\text{t}^{h}$	tklʌp
35.	*Constantine*	kon.stə.tin	tin.stən.kon	kon.stə.tin	tin.sə.kon	kon.stə.tin	tin.stə.kon
36.	*corpse*	kops	psko	kops	skop	kops	skop
37.	*crawl*	kwou	loːk^{w}	kwou	lə.kwoː	kɹoːl	loːk^{w}
38.	*crisp*	kɹisp	pkɹis	kɹisp	pgɹis	kɹisp	pə.gɹis
39.	*crow*	kɹou	ɹouk	kɹou	ouk^{w}	kɹou	oukɹ
40.	*crown*	kɹaun	aunk	kɹaun	nə.kɹau	kɹaun	nauk
41.	*cry*	kwai	aik^{w}	kɹai	aikɹ	kɹai	aikɹ
42.	*cube*	kjub	bjuk	kjuː.pə	pjuːk	kiub	biuk
43.	*digest*	dʌi.dʒest	dʒes.dzʌi	dʌi.dʒest	dʒes.dʌi	dʌi.dʒest	dʒes.dʌi
44.	*disband*	dis.bænt^{h}	bæn.dis	dis.bænt^{h}	bæn.dis	dis.bænt^{h}	bæn.dis
45.	*disclaim*	dis.gleim	gleim.dis	dis.gleim	gelim.dis	dis.gleim	gelim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌmt	tdʌn	dʌmpt	tdʌmp	dʌmpt	tə.dʌmp
48.	*east*	iːst	tiːs	iːst	tiːs	iːst	tis
49.	*eats*	its	tsi	its	sit	its	sit
50.	*Ed*	eːt	deː	eːt	deː	eːt	deː
51.	*edge*	eːdʒ	dʒeː	eːdʒ	dʒeː	eːtʃ	dʒeː
52.	*elf*	elf	fel	elf	fel	elf	fel
53.	*else*	els	sel	els	sel	els	sel
54.	*elves*	elvs	fsel	elfs	selfs	elfs	self
55.	*encourage*	in.kʌ.ɹeitʃ	ɹeitʃ.kʌ.in	in.kə.ɹeitʃ	ɹeitʃ.kʌ.in	in.kʌ.ɹeitʃ	ɹeitʃ.kʌ.in
56.	*encouraging*	in.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹi.kəɹ.in	in.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kʌ.in	in.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kʌ.in
57.	*English*	eŋ.gliʃ	gliʃ.eŋ	eŋ.gliʃ	gliʃ.eŋ	iŋ.gliʃ	gliʃ.iŋ
58.	*ex-con*	eks.kon	kon.eks	eks.kon	kon.eks	eks.kon	kon.eks
59.	*excuse*	eks.gius	giu.zeks	iks.gius	giu.seks	eks.gius	giu.seks
60.	*exhale*	iks.he.əl	hel.liks	eks.he.əl	hel.leks	eks.he.əl	hel.leks
61.	*explode*	eks.bloutʰ	blou.deks	eks.bloutʰ	blou.deks	eks.bloutʰ	blou.deks
62.	*fabric*	fæ.bɹik	bɹik.fæː	fæ.bɹik	bɹik.fæː	fæː.bɹik	bɹik.fæː
63.	*fact*	fækt	ktfæ	fækt	tə.fæk	fækt	tə.fæk
64.	*famed*	feimt	tfeim	feimt	tfeim	feimt	tfeim
65.	*fed*	fet	def	fet	def	fet	def
66.	*film*	fum	mə.fu	film	mə.fil	film.mə	mə.fil
67.	*fish*	fiʃ	ʃif	fiʃ	ʃif	fiʃ	ʃif
68.	*flap*	flæp	pælf	flæp	pə.flæ	flæp	pə.flæ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	fləːt	təlf	fləːt	tfləː	flʌt	tflʌ
70.	*flu*	flʉː	ʉːf	flʉː	lʉːf	flʉː	lʉːf
71.	*fly*	flai	aif	flai	aif	flai	laif
72.	*foolish*	fuː.liʃ	liʃ.fuː	fu.liʃ	liʃ.fu	fu.liʃ	liʃ.fu
73.	*frank*	fɹæŋk	kfɹæn	fɹæŋk	kfɹæn	fɹæŋk	kfɹæn
74.	*Franks*	fɹæŋks	ksfɹæn	fɹæŋks	sfɹæŋk	fɹæŋks	sfæŋk
75.	*free*	fɹiː	iːf	fɹiː	iːf	fɹiː	iːf
76.	*freshness*	fɹeʃ.nəs	nəs.fɹeʃ	fɹeʃ.nis	nəs.fɹeʃ	fɹeʃ.nis	nəs.fɹeʃ
77.	*friend*	fɹent^h	enf	fɹent^h	tə.fɹen	fɹent^h	tfɹen
78.	*fringe*	fɹintʃ	dʒfɹin	fɹintʃ	dʒfɹin	fɹintʃ	dʒfɹin
79.	*games*	geːms	sgeːm	geːms	sgeːm	gems	sgems
80.	*gasped*	gaspt	tgasp	gaspt	tgasp	gaːspt	tgaːsp
81.	*gasps*	gasps	sgasp	gæpsps	sgæps	gasps	sgap
82.	*gave*	geiv	veik	geiv	vgei	geiv	vgei
83.	*glue*	gluː	luːg	gluː	luːk	glʉː	luk
84.	*grab*	gɹaːp	bgɹaː	gɹæp	bə.gɹæ	gɹæp	bgɹæ
85.	*grant*	gɹant	tgɹan	gɹant	tgɹan	gɹant	tgwan
86.	*grape*	gɹeip	p.gɹei	gɹeip	p.gɹei	gɹeip	p.gɹei
87.	*help*	help	pə.hel	help	phel	help	pel
88.	*helped*	helpt	t.help	helpt	t.help	helpt	t.help
89.	*hobnob*	hop.nop	hop.hop	hʌp.nəp	nə.hʌp	hʌp.nəp	nəp.hʌp
90.	*implore*	im.ploː	ploː.im	im.ploː	ploː.im	im.ploː	plo.im
91.	*improve*	im.pɹuf	pɹuf.im	im.pɹuf	pɹu.vim	im.pɹuf	pɹu.vim

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	in.kɹi.ziŋ	ziŋ.kɹi.in	in.kɹi.ziŋ	ziŋ.kɹi.in	in.kɹi.ziŋ	ziŋ.kɹi.in
94.	*indefinite*	in.de.fə.nə	nə.fi.de.in	in.de.fi.nə	nə.fi.de.in	in.de.fi.nə	nə.fi.de.in
95.	*independent*	in.di.pen.dənt	dəm.pi.den.in	in.di.pen.dənt	dəm.pen.di.in	in.di.pen.dənt	dəm.pen.di.in
96.	*inflict*	in.flekt	fle.kin	in.flekt	flek.in	in.flekt	flek.tin
97.	*infuse*	in.fius	fiu.sin	in.fius	fiu.zin	in.fjus	fju.sin
98.	*ink*	iŋk	kiŋk	iŋk	kiŋ	iŋk	kiŋ
99.	*inked*	iŋt	tiŋ	iŋkt	diŋk	iŋkt	tiŋk
100.	*inks*	iŋks	siŋk	iŋks	siŋk	iŋks	siŋk
101.	*instinct*	in.sdiŋkt	sdiŋ.in	in.sdiŋkt	deŋs.in	in.sdiŋkt	tiŋkt.sin
102.	*instrument*	in.stɹu.mən	mən.stɹu.in	in.stɹu.mənt	mən.stɹu.in	in.stɹu.mənt	mən.stɹu.in
103.	*i-Tunes*	ʌi.tyns	tyn.sʌi	ʌi.tyns	tyn.sʌi	ʌi.tyns	tyn.sʌi
104.	*jasmine*	dʒæs.min	min.dʒæs	dʒæs.min	min.dʒæs	dʒʌs.min	mins.dʒʌs
105.	*jumps*	dʒʌmps	psdʒʌm	dʒʌmps	sdʒʌmp	dʒʌmps	sdʒʌmp
106.	*kept*	kept	tkep	kept	tkep	kept	tkep
107.	*lapse*	læps	pslæ	læps	pslæ	læps	slæp
108.	*lapsed*	læpst	stlæp	læpsts	tslæps	læpst	tə.læps
109.	*larks*	laːks	slaːks	laks	slak	laks	slak
110.	*lend*	$lent^h$	tlen	$lent^h$	dlent	$lent^h$	tə.len
111.	*lift*	lift	tə.lif	lift	tlif	lift	tə.lif
112.	*lisp*	lisp	pə.lis	lisp	pə.lis	lisp	pə.lis
113.	*lived*	lift	t.lif	lift	tlif	lift	tə.lif
114.	*lives*	laivs	sfail	laifs	sfaiv	laivs	sfaif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	koː	lok	klo	lok	kloː
116.	*log*	lo	go	lo	ok	lok^h	gol
117.	*lump*	lʌmp	plʌm	lʌmp	plʌm	lʌmp	plʌm
118.	*matched*	mætʃt	tə.mætʃ	mætʃt	tmætʃ	mætʃt	tmætʃ
119.	*melt*	melt	tə.mel	melt	tə.mel	melt	tə.mel
120.	*milk*	milk	kmil	milk	kmil	milk	kmil
121.	*misquote*	mis.kwout	kwou.mis	mis.gwout	gwou.mis	mis.kwout	kwou.mis
122.	*ounce*	aus	saun	auns	saun	auns	saun
123.	*owns*	ouns	son	ouns	soun	ouns	soun
124.	*ox*	oks	sko	oks	sok	oks	sok
125.	*participate*	pa.ti.sə.peit	pei.si.ti.pa	pa.ti.sə.pei	pei.si.tə.pa	pa.ti.sə.peit	pei.si.ti.pa
126.	*peacemaking*	piːs.mei.kiŋ	kiŋ.mek.piːs	piːs.mek.kiŋ	kiŋ.mei.piːs	piːs.mek.kiŋ	keŋ.mei.pis
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	fspʌ	pʌfs	fspʌ	pʌfs	spʌf
131.	*raised*	ɹeist	dweis	ɹeist	dɹeis	ɹeist	tɹeis
132.	*range*	ɹeintʃ	dɹein	ɹeintʃ	dɹein	ɹeindʒ	dɹein
133.	*recommend*	ɹe.kəm.ment^h	men.kən.ɹe	ɹe.kəm.ment^h	men.kən.ɹe	ɹe.kəm.ment^h	men.kən.ɹe
134.	*recruiter*	ɹi.kɹu.tə	tə.kɹu.ɹi	ɹi.ku.tə	tə.ku.ɹi	ɹi.ku.tə	tʌ.ku.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒu.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒu.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒu.ɹei.tə	tə.ɹei.dʒu.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	tɹʌʃ	ɹʌʃt	tɹʌʃ	ɹʌʃt	tɹʌʃ
139.	*scratch*	sgwætʃ	tʃsgwæ	sgwætʃ	tʃsgwæ	sgwætʃ	tʃsgwæ
140.	*scree*	sgwiː	gwiːs	sgwiː	gwiːs	sgwiː	gwiːs
141.	*segment*	se.mən	mən.se	sek.mən	mən.se	sek.mən	mən.se
142.	*senseless*	sens.ləs	ləs.sens	sens.ləs	ləs.sens	sens.ləs	ləs.sens
143.	*sequence*	siː.kwəns	kwən.siː	si.kwəns	kwən.si	si.kwəns	kwən.si
144.	*shameless*	ʃeim.ləs	ləs.ʃeim	ʃeim.ləs	ləs.ʃeim	ʃeim.ləs	ləs.ʃeim
145.	*shelve*	ʃelv	fʃel	ʃelf	fʃel	ʃelv	fʃel
146.	*shelved*	ʃelft	tʃelf	ʃelft	tʃelf	ʃelft	tʃelf
147.	*skate*	sgeit	geits	sgeit	keits	sgeit	keits
148.	*skating*	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei
149.	*slope*	slop	pouts	slop	pslou	slop	pslou
150.	*small*	smoːl	moːls	smoːl	moːls	smoːl	moːls
151.	*smooth*	smuθ	θums	smuθ	θums	smuθ	θums
152.	*snatch*	snætʃ	tʃsnæ	snætʃ	tʃsnæ	snætʃ	nætʃs
153.	*spa*	sbaː	baːs	sbaː	baːs	sbaː	baːs
154.	*spare*	sbeʌ	ʌ.sbe	sbeʌ	ə.sbe	sbæʌ	ə.sbæ
155.	*sphere*	sfiə	fiəs	sfiə	fiəs	sfiə	fiəs
156.	*spiritual*	sbi.ɹi.tʃəl	tʃəl.ɹi.sbi	sbi.ɹi.tʃəl	tʃəl.ɹi.sbi	sbi.ɹi.tʃəl	tʃəl.ɹi.sbi
157.	*splendid*	sblen.dit	dis.blen	sblen.dit	dis.blen	sblen.dit	dis.blen
158.	*split*	sblit	blis	sblit	blits	sblit	blits
159.	*spoil*	sboi.əl	əl.sboi	sboi.əl	əl.sboi	sboi.əl	əl.sboi
160.	*spray*	sbɹei	bɹeis	sbɹei	bɹeis	sbɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs
162.	*springs*	sbɹiŋs	sbɹiŋ	sbɹiŋs	sbɹiŋ	sbɹiŋs	sbɹiŋ
163.	*squeeze*	sgwiːs	gwiːs	sgwiːz	gwiːs	sgwiːs	gwiis
164.	*stain*	sdein	deins	sdein	deins	sdein	deins
165.	*star*	sdaː	daːs	sdaː	daːs	sdaː	daːs
166.	*string*	sdɹiŋ	ɹiŋst	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs
167.	*stupid*	sdju.pit^{h}	pi.sdju	sdju.pit^{h}	pi.sdju	sdju.pit^{h}	pi.sdju
168.	*suppose*	sə.pous	pou.səs	sə.pous	pou.sə	səp.pous	pou.sə
169.	*swim*	swim	mius	swim	wims	swim	wims
170.	*text*	tekst	ekst	tekst	teks	tekst	teks
171.	*thankful*	θæŋk.ful	ful.θæŋk	θæŋk.fu	ful.θæŋk	θæŋk.ful	fəl.θaŋk
172.	*trenched*	tʃentʃt	ttʃen	tʃentʃt	ttʃentʃ	tʃentʃt	tə.tʃentʃ
173.	*tweet*	twit	ti.wit	twit	twiː	twit	twiː
174.	*underpaid*	ʌn.də.peit^{h}	pei.də.ʌn	ʌn.də.peit^{h}	pei.də.ʌn	ʌn.də.peit^{h}	pei.də.ʌn
175.	*understand*	ʌn.də.sdænt^{h}	sdæn.də.ʌn	ʌn.də.sdænt^{h}	sdæn.də.ʌn	ʌn.də.sdænt^{h}	sdæn.də.ʌn
176.	*urge*	əːtʃ	dʒəː	əːtʃ	dʒəː	əːdʒ	dʒəː
177.	*Welsh*	welʃ	ʃwel	welʃ	ʃwel	welʃ	ʃwel
178.	*whereabout*	we.ɹə.baut	bau.ə.we	weː.ɹə.baut	bau.tə.weː	weː.ɹə.baut	bau.tə.ɹeː
179.	*wolf*	wuːf	fuː	wuːf	f.wuː	wuːf	fuː
180.	*woodland*	wu.lænt^{h}	læn.wuː	wu.lænt	læn.wut	wu.lænt^{h}	læn.wut

X. HK-F-29-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹeit	fɹei.daː	ʌ.fɹeit^{h}	t.fɹei.aː	ʌ.fɹeid	dɹei.faː
2.	*age*	eiʤ	ʧei	eidʒ	tʃei	eitʃ	tʃei
3.	*Alps*	æups	sæup	æups	spæu	æɒps	spæu
4.	*amuse*	ʌ.mjus	mjus.a	ʌ.mjuːs	sjuː.maː	ʌm.juːs	sjuː.maː
5.	*anguish*	æŋ.gwiʃ	gwiʃ.æn	æŋ.gwiʃ	ʃkwə.en	æŋ.geʃ	ʃəg.gæŋ
6.	*anklet*	æŋ.klət	klit.æn	eːŋ.klʌt	tlʌt.kæːn	æŋ.klət	tlʌt.kæːŋ
7.	*ant*	ænt	tæn	ænt	tæn	eːnt	tæːŋ
8.	*approve*	ʌ.pɹuːf	pɹuːf.aː	ʌ.pɹuːf	fɹuː.paː	ʌ.pɹuːf	pɹuːf.aː
9.	*ask*	aːsk	sk.aː	aːsk	ks.aː	aːsk	k.saː
10.	*asked*	aːskt	tks.aː	aːskt	tk.saː	aːsks	tk.saː
11.	*asks*	aːsks	sks.aː	aːsks	sks.aː	aːsks	sk.saː
12.	*bangs*	bæŋks	sgæŋp	bæːŋks	sgæːŋp	bæːŋks	sgæːŋp
13.	*begged*	begd	kt.bæp	bægd	d.gæːp	bæːkt	t.kæːp
14.	*begs*	bæks	skæb	bæːks	sgæːp	bæks	skæp
15.	*blast*	blaːst	staː.plə	blaːst	ts.aːlp	blaːst	t.saːp
16.	*bled*	bled	dleb	blæd	dæ.ləp	blæːd	dæ.lʌp
17.	*bloom*	bluːm	uːmbl	bluːm	uːnb	bluːm	uːmbl
18.	*blunt*	blʌnt	tlʌmp	blʌnt	tʌnb	blant	tʌnb
19.	*blur*	bləː	əːp	bləː	əː.ləp	bləː	əːp
20.	*brief*	bɹiːf	fɹiːp	bɹiːf	fɹiːp	bɹiːf	fɹiːp
21.	*Britain*	bɹit.tən	tʌn.bɹit	bɹit.tən	ʌn.tɹip	bɹe.ten	tʌn.bɹit
22.	*bronze*	bɹɒns	spɹɒn	bɹɒns	sɹɒmb	bɹɒːŋs	sɹɒːmb

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	dju:p	bju:d	dju:p	biud	dju:p
24.	*bulb*	ba:p	ba:p	bʌlp	bʌlp	ba:p	ba:p
25.	*bulbs*	ba:ps	s.ba:p	ba:ps	s.ba:p	ba:ps	spa:p
26.	*cashback*	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	kə.bæʃ.ke	kæʃ.bæk	bæk.kæʃ
27.	*clarify*	klæ.ɹi.fai	fai.ɹi.kle	klæ.ɹə.fai	fai.ɹi.kle	klæ.ɹə.fai	fai.ɹi.kle:
28.	*Clark*	kla:k	ka:kl	kla:k	ka:lk	kla:k	ka:wk
29.	*clear*	kli:.ə	ʌ.kli:	kli:.ə	a:.i:k	kli:.əɹ	a:.kli:
30.	*cliff*	klif	flik	kli:f	fli:k	kli:f	fli:k
31.	*close*	klous	so:lk	klous	so:lk	klous	soukl
32.	*closure*	klou.səɹ	sə:.klou	klou.səɹ	ə:.souk	klou.ʃə:	ʃə:.klou
33.	*clothing*	klou.ðiŋ	θiŋ.klou	klou.ðiŋ	iŋ.θou.klə	klou.θeŋ	θeŋ.klou
34.	*clubbed*	klʌp^{h}t^{h}	tp.kla:p	klʌp^{h}t^{h}	də.bla:pk	kla:p^{h}t^{h}	də.pa:pkl
35.	*Constantine*	kɒns.tʌn.tin	tin.tən.kɒns	kɒn.stən.tin	tin.tens.kɒ:n	kɒns.tʌn.ti:n	ti:n.tens.kɒ:n
36.	*corpse*	kɒps	s.kɒp	kɒps	spɒk	kɒ:ps	spɒ:k
37.	*crawl*	kɹɒ:l	o:kɹ	kɹɒ:l	o:kɹ	kɹɒ:	ɒ:kɹ
38.	*crisp*	kɹisp	sp.kɹɨ:	kɹisp	psk.iɹk	kɹisp.	ps.kɹə
39.	*crow*	kɹou	oukɹ	kɹou	ouɹk	kɹou	o:wkɹ
40.	*crown*	kɹaun	a:ŋkɹ	kɹaun	a:ŋkɹ	kɹa:w	a:ŋkɹ
41.	*cry*	kɹai	waikɹ	kɹai	aikɹ	kɹai	aikɹ
42.	*cube*	ky:p	p.ky:	ky:p	bu:k	ky:p	by:k
43.	*digest*	dai.ʤest	ʤes.dai	dai.ʤest	ts.ʤet.dai	dai.dʒe:st	ts.dʒe.dai
44.	*disband*	dis.bæn	bæn.dis	dis.bænt^{h}	dæn.bisd	dis.bæ:nt^{h}	bænt.dis
45.	*disclaim*	dis.kleim	kleim.dis	dis.kleim	eim.klʌ.dis	dis.kleim	kleim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.kʌs	kʌs.dis	dis.kaːs	skaːs.diː	dis.gaːs	skʌs.diː
47.	*dumped*	dʌmpt	tp.dʌm	dʌmpt	də.pʌmd	dʌmpt	də.pʌmd
48.	*east*	iːst	ts.iː	iːst	tsiː	iːst	tsiː
49.	*eats*	iːts	ts.iː	iːts	stiː	iːts	stiː
50.	*Ed*	eːd	deː	eːd	dæ	eːd	dæd
51.	*edge*	eːdʒ	dʒ.e	eːdʒ	dʒ.eː	æːdʒ	tʃæːd
52.	*elf*	euf	feu	euf	feu	euf	feu
53.	*else*	els	sel	eːws	seːw	eːws	sæːw
54.	*elves*	eufs	sfæu	eufs	seufs	æufs	sfæu
55.	*encourage*	eŋ.kəː.ɹeːtʃ	weidʒ.kəː.eːn	eŋ.kəː.ɹeitʃ	eidʒ.ɹəː.keːn	eŋ.kəː.ɹeːtʃ	weːdʒ.kəː.eːŋ
56.	*encouraging*	eŋ.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kəː.eŋ	eŋ.kʌ.ɹei.dʒiŋ	dʒiŋ.ɹei.kəɹ.eŋ	eŋ.kʌː.ɹe.dʒiŋ	dʒiŋ.ɹei.kəɹ.eːŋ
57.	*English*	iŋ.gliʃ	ʃu.lɨk.kə.iŋ	iŋ.gliʃ	slut.kə.eŋ	eŋ.gleʃ	ʃi.gliŋ
58.	*ex-con*	eks.kɒn	kɒn.eːks	eks.kɒɒn	kɒːn.eːks	eks.kɒːn	kɒn.neks
59.	*excuse*	eks.kjuːs	kjuːs.eks	eks.kjuːs	kjuːs.eks	eks.kjuːs	sjuːks.ek
60.	*exhale*	eks.heː.jəl	ou.heː.eks	eks.heː.ʌl	ou.heː.eks	eks.heː.ou	heː.oeːks
61.	*explode*	eks.ploutʰ	blou.eks	eks.plout	dou.lɨ.peks	eks.plout	d.blou.eks
62.	*fabric*	fæ.bɹik	bɹik.fæ	fæ.bɹik	kɹek.bæf	fæ.bɹek	kəɹ.bæf
63.	*fact*	fækt	tk.fæ	fækt	t.kæf	fækt	tækf
64.	*famed*	feind	deinf	feimt	deimf	feind	deimf
65.	*fed*	fed	def	fæd	def	fæd	def
66.	*film*	fim	imf	fim	imf	feːm	iːmf
67.	*fish*	fiʃ	ʃif	feʃ	ʃif	feʃ	ʃif
68.	*flap*	flæp	læpf	flæp	pælf	flæp	pælf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flə:t	ə:tfl	flə:t	tə:.lɨf	flə:t	tə:.lʌf
70.	*flu*	flu:	lu:f	flu:	lu:f	flu:	u:.luf
71.	*fly*	flai	laif	fla:j	a:j.lif	fla:j	a:j.lif
72.	*foolish*	fu:.liʃ	liʃ.fu:	fu:.leʃ	ʃi.le.u:f	fu:.leʃ	leʃ.fu:
73.	*frank*	fɹæŋk	kæŋf	fɹæŋk	kæɱf	fɹe:ŋk	kenfɹ
74.	*Franks*	fɹæŋks	sk.fɹæŋ	fɹæŋks	skæɱfɹ	fɹæŋks	skeɱfɹ
75.	*free*	fɹi:	ɹi:f	fɹi:	i:ɹf	fɹi:	i:.if
76.	*freshness*	fɹeʃ.nəs	nʌs.fɹeʃ	fɹeʃ.nəs	snʌs.ʃæfɹ	fɹæʃ.nes	nʌs.fɹæʃ
77.	*friend*	fɹent^{h}	denf	fɹent^{h}	denf	fɹænt^{h}	dɛɱfɹ
78.	*fringe*	fɹindʒ	tʃə.fɹin	fɹindʒ	tʃɹinf	fɹindʒ	tʃinfɹ
79.	*games*	geims	seiŋg	geims	seiŋg	geims	seimg
80.	*gasped*	gespt	tp.ges	gespt	gæspt	gævs.pt	tp.sæ:k
81.	*gasps*	gæp.sps	sips.gja:	gæsps	sps.æg	gæs.ps	sp.sæ:k
82.	*gave*	geif	f.gei	geif	veig	geif	veig
83.	*glue*	glu:	lu:k	glu:	u:l(u)k	glu:	u:lk
84.	*grab*	gɹæp	æpgɹ	gɹæ:b	bæ:gɹ	gɹæp	bæɹ.gə
85.	*grant*	gɹa:nt	ta:ngɹ	gɹa:nt	ta:ɹŋ.gə	gɹa:nt	ta:ŋ.gɹə
86.	*grape*	gɹeip	eip.gɹə	gɹeip	pei.gɹə	gɹeip	peigɹ
87.	*help*	heup	peuh	hæup	pæuh	hæup	pæuh
88.	*helped*	hæupt	t.hæup	hæupt	tp.eu	hæupt	tp.hæu
89.	*hobnob*	hɒp.nɒp	nɒp.hɒp	hɒp.nɒp	nɒp.hɒp	hɒp.nɒ:p	nɒp.hɒ:p
90.	*implore*	im.plɒ:	plɒ:.im	im.plo:.a	ʌ.plɒ:.im	im.plo:.a	ʌ.plɒ:.im
91.	*improve*	im.pɹu:f	pɹu:f.i:m	jim.pɹu:f	pɹu:f.i:m	im.pɹu:f	fɹu:.pi:m

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃəʔ.in	intʃ	tʃin	entʃ	tʃen
93.	*increasing*	iŋ.kwiː.zeŋ	seŋ.kɹiː.iːn	iŋ.kwiː.zeŋ	seŋ.kwiː.iːn	iŋ.kwiː.zeŋ	seŋ.kɹiː.iːn
94.	*indefinite*	in.dæ.fi.nɔːt	nʌt.fʌn.dæ.iːn	in.dæ.fi.net	nʌt.fʌn.dæ.iːn	in.dæ.fi.nɔːt	nə.fən.dʌ.əːn
95.	*independent*	in.di.pen.dənt	dʌn.pen.di.in	iːn.di.pen.dənt	dʌn.pæn.di.iːn	in.di.pæn.dʌnt	dʌnt.pæn.di.iːn
96.	*inflict*	in.flekt	flekt.in	in.flekt	təfl.in	in.flekt	tk.flen
97.	*infuse*	in.fjuːs	fjuːs.in	in.fjuːs	sjuː.vin	in.fjuːs	sjuː.fiːn
98.	*ink*	iŋk	kiŋ	iŋk	kiŋ	eŋk	keŋ
99.	*inked*	iŋkt	kt.iŋ	eŋkt	d.keŋ	eŋkt	t.keŋ
100.	*inks*	iŋks	skiŋ	iŋks	skiŋ	eŋks	skiŋ
101.	*instinct*	in.stiŋkt	kt.stiŋ.in	in.steŋkt	teŋk.siːn	in.steːŋt	teŋ.stiːn
102.	*instrument*	in.stɹu.mənt	mʌn.stɹu.in	ins.tɹu.ment	mʌn.tɹu.iːns	ins.tɹu.ment	mʌn.tʃuɹ.siːn
103.	*i-Tunes*	ai.tjuns	sun.tai	ai.tjuːns	sun.taːj	ai.tjuːns	sun.taːj
104.	*jasmine*	dʒæs.min	mən.dʒæs	dʒæs.men	ʌns.dʒæ	dʒæz.men	mʌn.dʒæs
105.	*jumps*	dʒʌmps	spʌmdʒ	dʒamps	spamdʒ	dʒʌmps	spʌmdʒ
106.	*kept*	keːpt	teːpk	kæpt	tp.hæk	kæpt	t.pæk
107.	*lapse*	læps	slæp	læps	spæl	læps	spæl
108.	*lapsed*	læpst	sit.læp	læpst	ds.pæl	læpst	də.spæə
109.	*larks*	laːks	skaː	laːks	skaːl	laːks	skaːl
110.	*lend*	lend	den	leːnd	dæŋv	lend	dænb
111.	*lift*	lift	tif.lə	lift	tf.lət	leːft	tfeːl
112.	*lisp*	lisp	sp.lə	lisp	ps.lət	lisp	ps.liː
113.	*lived*	lift	ft.liː	lift	t.fle	liːft	t.flit
114.	*lives*	laivs	zvlai	laifs	sfail	laifs	sfail

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lɒk	klɒ	lɒk	kɒ	lɒk	kɒl
116.	*log*	lɒk	glɒ	lɒk	gɒː	lɒg	gɒ
117.	*lump*	lamp	pam	lamp	paːm	laːmp	paːm
118.	*matched*	mætʃt	ttʃ.mæ	mætʃt	ttʃ.mæ	maːtʃt	ttʃ.tʃaːm
119.	*melt*	meut	t.mæu	mæut	tæum	maut	tæum
120.	*milk*	mjuːk	kjum	mjuːk	kjuːm	mjuːk	kjuːm
121.	*misquote*	mis.kwout	kwout.mis	mis.kwout	kwout.mis	mis.kʌːwt	kout.mes
122.	*ounce*	ɒns	sɒn	ɒns	sɒːn	ɒːns	sɒ.ʌŋ
123.	*owns*	ouŋs	souŋ	ous	sou	ouŋs	souŋ
124.	*ox*	ɒks	sɒk	ɒks	sɒ	ɒːks	sɒː
125.	*participate*	pʌ.ti.sʌ.pei	pei.sʌ.tip.taː	pʌ.ti.sʌ.pei	pei.si.tʌ.paː	pʌ.ti.sʌ.peit	pei.si.tə.paː
126.	*peacemaking*	piːs.meː.kiŋ	kiŋ.mei.piːs	piːs.meː.kiŋ	kiŋ.mei.sʌ.piː	piːs.meː.kiŋ	keŋ.meːks.piː
127.	*play*	plei	eipl	plei	eil.p	plei	eil.p
128.	*pray*	pɹei	eipɹ	pɹei	eip	pɹei	eipɹ
129.	*presidency*	pɹæ.si.dən.si	siː.dən.sʌ.pɹe	pɹe.si.dən.si	siː.dən.sə.pɹeː	pɹæ.si.dən.siː	siː.dən.sə.pɹeː
130.	*puffs*	pafs	spaf	pafs	sfap	pafs	sfap
131.	*raised*	ɹeist	st.ɹei	ɹeist	ts.eiɹ	ɹeist	də.sei.vɹ
132.	*range*	ɹeːŋdʒ	tʃ.ɹeŋ	ɹeːŋdʒ	tʃeːŋ.ɹ̥ɨ	ɹeːŋdʒ	tʃeːŋ.ɹə
133.	*recommend*	ɹe.kə.meːnd	meŋ.kə.ɹe	ɹæ.kə.meːnt^{h}	meːnd.kə.ɹæʔ	ɹe.kə.meːnt^{h}	dæ.mə.kɹeʔ
134.	*recruiter*	viː.kuː.taː	taː.kuɹ.ɹiː	viː.kuː.taː	taː.kuɹ.viː	viː.kɹu.taː	taː.kuɹ.ɹiː
135.	*refrigerator*	ɹi.fɹi.dʒə.ɹei.ta	ta.ɹi.dʒə.fɹei.ɹi	ɹi.fɹi.dʒə.ɹei.taː	ta.ɹi.dʒə.fɹei.ɹiː	ɹe.fɹi.dʒə.ɹei.taː	tʌ.ɹei.dʒe.fid.ɹiː
136.	*relationship*	vi.lei.ʃʌn.ʃip	ʃip.ʃʌn.lei.wiː	ɹi.lei.ʃʌn.ʃip	ʃip.ʃʌn.nei.wiː	ɹi.lei.ʃʌn.ʃip	ʃip.ʃʌn.nei.wiː
137.	*representative*	ɹæ.pə.sæn.tə.tif	tiːf.tə.sæm.pi.ɹe	ɹe.pɹə.sen.tə.tif	tiːf.tə.sæm.pe.ɹe	ɹæ.pə.sen.tə.tif	tif.tə.sæm.pi.ɹeː

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌst	ts.ɹʌ	ɹaːst	ts.ɹaːt	ɹaːst	ts.ɹaːt
139.	*scratch*	skɹætʃ	tʃus.gɹæ	skɹætʃ	tʃæ.kɹs	skɹæːtʃ	tʃæ.kɹs
140.	*scree*	skɹiː	kɹiːs	skɹiː	iː.gɹes	skwiː	iː.ks
141.	*segment*	seg.mənt	mʌn.seg	seg.ment	tʌm.ges	sæg.ment	mʌn.sæg
142.	*senseless*	sens.ləs	lʌs.sens	sens.ləs	slʌs.sens	sens.lʌs	ləs.sens
143.	*sequence*	siː.kwens	s.kwʌn.siː	siː.kwens	skwʌn.siː	siː.kwens	skwʌn.siː
144.	*shameless*	ʃeim.las	lʌs.ʃeim	ʃeim.les	slʌ.eimʃ	ʃeim.les	lʌs.ʃeim
145.	*shelve*	ʃauf	fə.ʃau	ʃauf	væuʃ	ʃauf	væuʃ
146.	*shelved*	ʃauft	df.æuʃ	ʃauft	dif.auʃ	ʃauft	t.feuʃ
147.	*skate*	skeit	t.keis	skeit	d.geis	skeit	teiks
148.	*skating*	skei.teŋ	teŋ.skei	skei.teŋ	eŋ.teiks	skei.teŋ	teŋ.skei
149.	*slope*	sloːp	loːps	sloːp	poːlps	sloːp	bous
150.	*small*	smoːl	ɒːsm	smɒː	ɒː.mus	smɒː	ɒː.mus
151.	*smooth*	smuːθ	θmuːs	smuːθ	θmuːms	smuːθ	θuːms
152.	*snatch*	snætʃ	tʃs.ne	snætʃ	tʃt.næs	snætʃ	tʃnæs
153.	*spa*	spaː	aːps	spaː	aːps	spaː	aːps
154.	*spare*	speː	eːsp	speː.ə	eː.æps	speː.ə	aː.jæps
155.	*sphere*	sfiː.ə	aː.sfiː	sfiː.ə	aː.fiːs	sfiː.ə	aː.fiːs
156.	*spiritual*	spi.ɹi.tʃʌu	tʃoː.ɹʌs.piː	spi.ɹi.tʃʌu	ou.tɹiː.iːps	spi.ɹi.tʃʌu	tʃou.ɹis.beː
157.	*splendid*	splen.did	di.splen	splen.dəd	də.en.ləps	splæn.dit	did.splæn
158.	*split*	split	tlips	splet	ti.leps	spləːt	tlʌps
159.	*spoil*	spɒi.ou	ɒi.ousp	spɒi.ou	ou.bɒis	spɒi.ɒu	ou.bɒis
160.	*spray*	spɹei	ei.pɹəs	spɹei	ei.ups	spɹei	eispɹ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹiŋ	iŋspɹ	spɹiŋ	eŋ.ɹsp	spɹeŋ	eŋpɹs
162.	*springs*	spɹiŋs	sɹiŋps	spɹe:ŋs	seŋ.ɹups	spɹe:ŋs	seŋspɹ
163.	*squeeze*	skwi:s	zə.i:skw	skwi:s	si:.kus	skwi:s	si:.kus
164.	*stain*	ste:ŋ	e:ŋst	steiŋ	eiŋts	ste:ŋ	e:ŋts
165.	*star*	staː	a:st	staː	a:.təs	staː	a:ts
166.	*string*	stɹeiŋ	eŋstɹ	stɹeiŋ	eŋstɹ	stɹe:ŋ	eŋ.stɹ
167.	*stupid*	stju:.bəd	bə.stjuː	stju:.bet	dep.ju:ts	stju:.bet	ded.bju:s
168.	*suppose*	sʌp.pous	pous.sʌp	sʌp.pous	sou.pʌs	sʌ.pous	sou.pes
169.	*swim*	swim	imsw	swi:m	jim.mus	swim	jim.mus
170.	*text*	tækst	ts.ækt	tækst	ts.ækt	tækst	ts.ækt
171.	*thankful*	θæŋk.fou	fou.θæŋk	θæŋk.fou	ouf.kænθ	θæŋk.fou	fou.θæŋk
172.	*trenched*	tɹentʃt	ttʃ.tɹen	tɹentʃt	tʃ.tʃentɹ	tʃæntʃt	tʃu.tʃætʃ
173.	*tweet*	twi:t	ti:tw	twi:t	ti:.wit	twi:t	ti:tw
174.	*underpaid*	ʌn.də.peid	pei.də.ʌn	ʌn.də.pei	pei.də.an	ʌn.də.peid	dei.pə.da:n
175.	*understand*	ʌn.də.stæn	stæn.də.ʌn	ʌn.də.stæn	dæn.stə.an	ʌn.də.stæn	dens.tə.ʌn
176.	*urge*	ə:dʒ	dʒ.əː	ə:dʒ	tʃəː	əɹtʃ	tʃəɹ
177.	*Welsh*	wauʃ	swau	wæuʃ	ʃwæu	wæuʃ	ʃwæu
178.	*whereabout*	ve:.ɹʌ.bʌut	bʌut.vʌ.ɹeː	we:.ɹʌ.baut	bʌu.tʌ.we:.ə	we:.ɹʌ.baut	bʌu.tʌ.ve:.ə
179.	*wolf*	wo:f	fwoː	wo:f	fwoː	wo:f	fwoː
180.	*woodland*	wud.læn	lænd.wud	wud.lænd	dæn.duː	wud.læ:nd	lænd.wu:d

Appendix 9

List of Transcriptions for Each Guangzhou Informant in the Production Test[♠]

I. GZ-M-19-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	də.fɹei.ə	ə.fɹeit	tfɹei.ə	ə.fɹeit	dfɹei.ə
2.	*age*	eitʃ	tʃ.ei	eitʃ	tʃ.ei	eitʃ	tʃ.ei
3.	*Alps*	ælps	sp.æl	ælps	sp.æl	ælps	sp.æl
4.	*amuse*	ə.mius	smiu.ə	ə.mius	smiu.ə	ə.mjuːs	smiu.ə
5.	*anguish*	æŋ.gwiʃ	ʃgwi.æn	eŋ.gwiʃ	ʃgwi.en	eŋ.gwiʃ	ʃgwi.en
6.	*anklet*	æŋ.kli	lik.en	æŋ.klit	tlik.æn	eŋ.kli	lik.en
7.	*ant*	ænt	tæn	ænt	tæn	ænt	tæn
8.	*approve*	ə.pɹuːf	ɹuf.pə.ə	ə.pɹuːf	fɹu.pə.ə	ə.pɹuf	fpɹu.ə
9.	*ask*	aːsk	kəs.aː	aːsk	ks.aː	ask	kəs.aː
10.	*asked*	askt	dks.aː	askt	dks.aː	askt	də.kəs.aː
11.	*asks*	asks	skas	asks	sks.aː	asks	sks.aː
12.	*bangs*	bæŋs	sbæŋ	bæŋs	sbæŋ	bæŋs	sbæŋ
13.	*begged*	bekt	tkbe	bekt	tkbe	bekt	dgbe
14.	*begs*	beks	skbe	beks	skbe	beks	skbe
15.	*blast*	blaːst	tslaːp	blaːst	tslaːp	blaːst	tslaːp
16.	*bled*	blet	dlep	blet	dlep	blet	dlep

[♠] The data are from the research project GRFHKBU250712 (P.I.: Lian-Hee Wee).

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
17.	*bloom*	bə.luːm	luːmp	blum	lump	blum	lump
18.	*blunt*	blʌnt	tlʌmp	blʌnt	tlʌmp	blʌnt	tlʌmp
19.	*blur*	bləːɹ	ləɹp	bləː	ləːp	bləːɹ	ləːp
20.	*brief*	bɹiːf	fɹiːp	bɹiːf	fɹip	bɹiːf	fɹiːp
21.	*Britain*	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	tən.bɹi
22.	*bronze*	bɹans	sɹamp	bɹans	sɹamp	bɹons	sbɹon
23.	*build*	biut	t.iup	biut	dbiu	biut	dbiu
24.	*bulb*	bʌup	bʌup	bʌup	bʌup	bʌup	bʌup
25.	*bulbs*	bʌups	sbʌup	bʌups	sbʌup	bʌups	sbʌup
26.	*cashback*	kæʃ.bæk	bæʃ.kæ	kæʃ.bæk	kbæʃ.kæ	kæʃ.bæk	kbæʃ.kæ
27.	*clarify*	kle.ɹi.fai	fai.ɹi.lek	kle.ɹi.fai	fai.ɹi.lek	kle.ɹi.fai	fai.ɹi.lek
28.	*Clark*	klaːk	klaːk	klaːk	klaːk	klaːk	klaːk
29.	*clear*	kliəɹ	ə.lik	kliəɹ	ə.lik	kliə	ə.lik
30.	*cliff*	klif	flik	klif	flik	klif	flik
31.	*close*	klous	slouk	klous	slouk	klous	slouk
32.	*closure*	klou.ʃə	ʃə.louk	klou.ʃə	ʃə.louk	klou.ʃə	ʃə.louk
33.	*clothing*	klou.diŋ	diŋ.louk	klou.diŋ	diŋ.louk	klou.diŋ	diŋ.klou
34.	*clubbed*	klʌbd	dblʌk	klʌbd	dblʌk	klʌpt	dblʌk
35.	*Constantine*	kon.stən.tin	tin.tən.skon	kon.stən.tin	tin.tən.skon	kon.stən.tin	tin.tən.skon
36.	*corpse*	kops	spkoː	koːs	spkoː	kops	spkoː
37.	*crawl*	kɹoːl	ɹoːlk	kɹoːl	ɹoːlk	kɹoːl	ɹoːlk
38.	*crisp*	kɹisp	pskɹiː	kɹisp	pskɹi	kɹisp	pskɹi
39.	*crow*	kɹou	ɹouk	kɹou	ɹouk	kɹou	ɹouk

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
40.	*crown*	kɹaːn	ɹaːŋk	kɹan	ɹaŋk	kɹaŋ	ɹaŋk
41.	*cry*	kɹai	ɹaik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kiub	bkiu	kiup	bkiu	kiup	bkiu
43.	*digest*	dʌi.dʒest	tsdʒe.dʌi	dʌi.dʒest	təs.dʒe.dʌi	dʌi.dʒest	tsdʒe.dʌi
44.	*disband*	dis.bænd	bæn.sdi	dis.ben	ben.sdi	dis.ben	ben.sdi
45.	*disclaim*	dis.kleim	lem.kə.sdi	dis.kleim	leim.kəs.dit	dis.kleim	leim.kəs.dit
46.	*discuss*	dis.gʌs	sgʌ.sdi	dis.gʌs	sgʌ.sdi	dis.gʌs	sgʌ.sdi
47.	*dumped*	dʌmpt	dəp.dʌm	dʌmpt	tpdʌm	dʌmpt	tpdʌm
48.	*east*	iːst	ts.iː	ist	ts.iː	ist	ts.iː
49.	*eats*	its	st.iː	its	st.iː	its	st.iː
50.	*Ed*	et	de	et	de	et	de
51.	*edge*	etʃ	tʃ.et	etʃ	tʃ.e	etʃ	tʃ.e
52.	*elf*	elf	fel	elf	fel	elf	fel
53.	*else*	els	s.el	els	s.el	els	s.el
54.	*elves*	elfs	sf.el	elfs	sf.el	elfs	sf.el
55.	*encourage*	in.kə.ɹitʃ	tʃ.ɹə.kəɹ.in	in.kə.ɹeitʃ	tʃɹei.kə.in	in.kə.ɹeitʃ	tʃ.ɹi.kə.in
56.	*encouraging*	in.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	in.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	in.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in
57.	*English*	iŋg.liʃ	ʃli.iŋ	iŋg.liʃ	ʃli.iŋ	iŋg.liʃ	ʃliʔ.iŋ
58.	*ex-con*	eks.kon	kons.ek	es.kon	kons.ek	es.kon	kons.ek
59.	*excuse*	is.kjuːs	kju.sik	iks.kius	skius.ik	iks.kius	skius.ik
60.	*exhale*	iks.hel	helks.ik	iks.hel	hels.ik	iks.hel	hels.ik
61.	*explode*	iks.plout	də.lou.piks	iks.plout	də.lou.pəs.ik	iks.plout	dplous.ik
62.	*fabric*	fæ.bɹik	ɹik.bæf	fæ.bɹik	kbɹi.fæ	fe.bɹik	kə.ɹi.bef

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
63.	*fact*	fæt	tfæ	fækt	tfæ	fæt	tfæ
64.	*famed*	feimt	dfeim	feimt	dfeim	feimt	dfeim
65.	*fed*	fet	def	fet	dfe	fet	def
66.	*film*	fium	miuf	fium	miuf	fium	iunf
67.	*fish*	fiʃ	ʃfi	fiʃ	ʃfi	fiʃ	ʃfi
68.	*flap*	flep	plef	flep	plef	flæp	plæf
69.	*flirt*	flə:t	lətf	flə:ɹt	tlə:ɹf	flə:t	tlə:f
70.	*flu*	fuː	lu:f	fluː	lu:f	fluː	lu:f
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	ʃli.fuː	fu.liʃ	ʃli.fuː	fu.liʃ	ʃli.fu
73.	*frank*	fɹeŋk	kɹenf	fɹeŋk	kfɹen	fɹeŋk	kfɹen
74.	*Franks*	fɹeŋks	skfɹen	fɹeŋks	skfɹen	fɹenks	skfɹen
75.	*free*	fɹiː	ɹi:f	fɹiː	ɹi:f	fɹi	ɹif
76.	*freshness*	fɹeʃ.nis	sniʃ.ɹef	fɹeʃ.nis	sniʃ.fɹe	fɹeʃ.nis	sniʃ.fɹe
77.	*friend*	fɹend	en.fɹi	fɹend	dɹen	fɹend	dfɹen
78.	*fringe*	fɹiŋtʃ	dʒɹiŋf	fɹiŋtʃ	dʒɹiŋf	fɹiŋtʃ	tʃɹiŋf
79.	*games*	geims	sgeim	geims	sgeim	geims	sgeim
80.	*gasped*	gespt	tpsge	gespt	də.pəs.ge	gespt	də.pəs.gæ
81.	*gasps*	gesps	spsge	gesps	spsge	gesps	spsge
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	gluː	lu:k	gluː	lu:k	gluː	lu:k
84.	*grab*	gɹep	bɹek	gɹep	pgɹe	gɹep	pgɹe
85.	*grant*	gɹent	tgɹen	gɹent	tgɹen	gɹent	tgɹen

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
86.	*grape*	gɹeip	pə.ɹeik	gɹeip	pgɹei	gɹeip	pgɹei
87.	*help*	help	phel	help	phel	help	phel
88.	*helped*	helpt	dphel	helpt	tphel	helpt	tphel
89.	*hobnob*	hop.nop	nop.hop	hop.nop	nop.hop	hop.nop	nop.hop
90.	*implore*	im.ploː	loːp.im	im.ploː	lop.im	im.ploː	lop.im
91.	*improve*	im.pɹuːf	fpɹu.in	im.pɹuf	fpɹu.im	im.pɹuf	fpɹu.in
92.	*inch*	intʃ	tʃ.in	intʃ	tʃ.in	intʃ	tʃ.in
93.	*increasing*	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fi.nit	ni.fin.de.in	in.de.fi.ni	ni.fin.de.in	in.de.fi.ni	ni.fən.de.in
95.	*independent*	in.di.pen.dən	dəm.pen.di.in	in.di.pen.dən	dəm.pen.di.in	in.di.pen.dən	dəm.pen.di.in
96.	*inflict*	in.flik	lik.fin	in.flet	tlekf.in	in.flit	tə.lif.in
97.	*infuse*	in.fius	sfiu.in	in.fius	sfiu.in	in.fius	sfiu.in
98.	*ink*	iŋk	kiŋ	iŋk	kin	iŋk	kin
99.	*inked*	iŋkt	dk.in	iŋkt	tk.in	iŋkt	dk.in
100.	*inks*	iŋks	skiŋ	iŋks	sk.iŋ	iŋks	sk.in
101.	*instinct*	in.stiŋt	t.tiŋs.in	in.stiŋt	t.tiŋs.in	in.stiŋt	t.tiŋs.in
102.	*instrument*	ins.tɹə.mən	mən.tɹəs.in	ins.tɹə.mən	mən.tɹəs.in	ins.tɹə.mən	mən.tɹəs.in
103.	*i-Tunes*	ʌi.tyns	styn.ʌi	ʌi.tyns	styn.ʌi	ʌi.tyns	styn.ʌi
104.	*jasmine*	dʒæs.min	min.sdʒæ	dʒes.min	min.sdʒe	dʒes.min	min.sdʒe
105.	*jumps*	dʒʌmps	spdʒʌmp	dʒʌmps	spdʒʌm	dʒʌmps	spdʒʌm
106.	*kept*	kept	tkep	kept	tpkeʔ	kept	tkep
107.	*lapse*	læps	sblæ	læps	splæ	læps	splæ
108.	*lapsed*	lepst	tsple	læpst	dəs.plæ	læpst	dəs.plæ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
109.	*larks*	la:ks	sklaː	la:ks	sklaː	la:ks	sklaː
110.	*lend*	lent	dlen	lent	dlen	lend	dlen
111.	*lift*	lift	təf.liː	lift	təf.li	lift	tfliː
112.	*lisp*	lisp	pəs.li	lisp	plis	lisp	psliː
113.	*lived*	lift	dəf.li	lift	dəf.li	lift	dəf.liː
114.	*lives*	laifs	sflai	laifs	sflai	laifs	sflai
115.	*lock*	lok	klo	lok	klo	lok	klo
116.	*log*	log	glo	log	glo	lok	glo
117.	*lump*	lʌmp	plʌm	lʌmp	plʌm	lʌmp	plʌm
118.	*matched*	metʃt	detʃ.mə	mætʃt	dətʃ.mæ	mætʃt	dətʃ.mæ
119.	*melt*	melt	tmel	melt	tmel	melt	tmel
120.	*milk*	miuk	kmiu	miuk	kmiu	miuk	kmiu
121.	*misquote*	mis.kwout	tkwous.mi	mis.kwout	tkwous.mi	mis.kwout	tkwous.mi
122.	*ounce*	a:ns	s.a:n	a:ŋs	s.a:ŋ	a:ŋs	s.a:ŋ
123.	*owns*	ons	s.on	ons	s.on	ons	s.on
124.	*ox*	ɒks	sk.ɒ	oks	sk.o	oks	s.oʔ
125.	*participate*	paɹ.ti.si.peit	pei.si.ti.pʌ	pʌ.ti.si.pei	pei.si.ti.paː	pʌ.ti.si.pei	pei.si.ti.pʌ
126.	*peacemaking*	pis.mei.kiŋ	kiŋ.meiʃ.piː	pis.mei.kiŋ	kiŋ.meis.pi	pis.mei.kiŋ	kiŋ.meis.pi
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.den.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	sfpʌ	pʌfs	sfpʌp	pʌfs	sfpʌ
131.	*raised*	ɹeist	dəs.ɹei	ɹeist	dəs.ɹei	ɹeist	dəs.ɹei

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
132.	*range*	ɹeintʃ	tʃɹein	ɹeintʃ	tʃɹei	ɹeintʃ	tʃɹein
133.	*recommend*	ɹe.kə.men	men.kən.ɹe	ɹe.kə.men	men.kən.ɹe	ɹe.kə.men	men.kən.ɹe
134.	*recruiter*	ɹi.kɹu.tə	tə.ɹu.kə.ɹi	ɹi.kɹu.tə	tə.kɹu.ɹi	ɹi.kɹu.tə	tə.kɹu.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒi.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.wei.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃi.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃi.ʃən.nei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	fti.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	fti.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	fti.tə.sem.pɹi.ɹe
138.	*rushed*	ɹʌʃt	dʃɹʌ	ɹʌʃt	dəʃ.ɹʌ	ɹʌʃt	tʃɹʌ
139.	*scratch*	sgɹetʃ	tʃgɹes	sgɹetʃ	tʃgɹes	sgɹetʃ	tʃgɹes
140.	*scree*	skɹiː	ɹiːks	skɹiː	kɹiːs	skɹiː	ɹiːks
141.	*segment*	sek.mən	men.sik	sik.mən	mən.sek	sek.mən	mən.sek
142.	*senseless*	sens.lis	slis.sen	sens.lis	slis.sen	sens.lis	slis.sen
143.	*sequence*	si.kwəns	skwən.siː	si.kwəns	skwən.siː	si.kwəns	skwən.siː
144.	*shameless*	ʃeim.nis	sli.ʃeim	ʃei.lis	sli.ʃeim	ʃeim.lis	sli.ʃeim
145.	*shelve*	ʃelf	f.elʃ	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelft	dfʃel	ʃelft	dfʃel	ʃelft	dfʃel
147.	*skate*	sgeit	tgeis	sgeit	tgeis	sgeit	tgeis
148.	*skating*	sgei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis
149.	*slope*	sloup	pə.lous	sloup	plous	sloup	plous
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuːf	fmuːs	smuːf	fmuːs	smuːf	fmuːs
152.	*snatch*	snætʃ	tʃnæs	snetʃ	tʃnes	snetʃ	tʃnes
153.	*spa*	sbaː	bas	sbaː	baːs	sbaː	baːs
154.	*spare*	sbe.əɹ	ə.bes	sbeəɹ	ə.bes	sbeəɹ	ə.bes

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
155.	*sphere*	sfi.ə	əː.fis	sfi.əɹ	əɹ.fis	sfi.əɹ	ə.fis
156.	*spiritual*	sbi.ɹi.tʃəl	tʃəl.ɹi.pis	sbi.ɹi.tʃəl	tʃəl.ɹi.pis	sbi.ɹi.tʃəl	tʃəl.ɹi.pis
157.	*splendid*	splen.di	di.lem.pəs	splen.di	di.lem.pis	sblen.dit	di.lemps
158.	*split*	sblit	tlips	sblit	tlips	sblit	tlips
159.	*spoil*	sbo.jil	oilps	sbo.jil	oilps	sbo.jil	əu.oips
160.	*spray*	spɹei	ɹeips	sbɹei	ɹeips	sbɹei	bɹeis
161.	*spring*	sbɹiŋ	ɹiŋps	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs
162.	*springs*	sbɹiŋs	sɹiŋps	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs
163.	*squeeze*	sgwiːs	sgwiːs	sgwiːs	sgwiːs	sgwiːs	sgwiːs
164.	*stain*	sdein	deins	sdein	deins	sdein	deins
165.	*star*	sdaː	daːs	sdaːɹ	daːɹs	sdaː	daːs
166.	*string*	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs
167.	*stupid*	sdju.pit	pit.djuːs	sdju.pit	pit.djuːs	sdju.pit	pit.djuːs
168.	*suppose*	sə.pous	spou.sə	sə.pous	spou.sə	sə.pous	spou.sə
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tekst	təs.tek	tekst	ts.ekt	tekst	təs.teʔ
171.	*thankful*	fæŋk.fəu	fəuk.fæn	fæŋk.fəu	fəu.fæŋ	fæŋ.fəu	fəu.fæŋ
172.	*trenched*	tʃentʃt	dətʃ.ɹentʃ	tʃentʃt	dətʃ.ɹentʃ	tʃentʃt	dtʃentʃ
173.	*tweet*	twiːt	twiːt	twit	twit	twiːt	twiːt
174.	*underpaid*	ʌn.də.peit	də.pei.də.ən	ʌn.də.peid	dpei.də.ən	ʌn.də.pei	pei.də.ʌn
175.	*understand*	ʌn.də.sdend	dens.də.ən	ʌn.də.sden	dens.də.ən	ʌn.də.sden	dens.də.ən
176.	*urge*	əːtʃ	tʃ.əːɹ	əːtʃ	tʃ.əː	əːtʃ	tʃ.əːɹ
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃ.wel	welʃ	ʃ.wel

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
178.	*whereabout*	we.ə.ə.baut	tbau.ə.ə.we	we.ə.ə.baut	tbau.ə.ə.we	we.ə.baut	tbau.ə.ə.we
179.	*wolf*	wuːf	f.wuː	wuːf	f.wuː	wuːf	f.wuː
180.	*woodland*	wut.lent	len.wut	wut.len	len.wut	wut.len	len.wut

II. GZ-F-23-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	də.fɹei.ə	ə.fɹeid	də.fɹei.ə	ə.fɹeid	də.fɹei.ə
2.	*age*	eidʒ	dʒ.ei	eidʒ	dʒ.ei	eidʒ	dʒ.ei
3.	*Alps*	elps	sp.el	elps	sp.el	elps	sp.el
4.	*amuse*	ə.mius	smiu.ə	ə.mius	sz.miu.ə	ə.mius	smiu.ə
5.	*anguish*	en.gwiʃ	gwiʃ.en	en.gwiʃ	ʃy.gwi.en	en.gwiʃ	ʃy.gwi.en
6.	*anklet*	en.klit	lit.kə.en	en.klit	tə.li.kəu.en	eŋ.klit	tli.kə.en
7.	*ant*	ent	t.en	ent	t.en	ent	t.en
8.	*approve*	ə.plu:f	v.plu.ə	ə.pluf	fv.plu.ə	ə.pluf	fv.plu.ə
9.	*ask*	ask	kəs.aː	ask	kəs.aː	ask	kəs.aː
10.	*asked*	askt	təks.aː	askt	təks.aː	askt	tks.a
11.	*asks*	asks	skəs.aː	as.kəs	skəs.a	asks	sks.a
12.	*bangs*	bens	sben	beŋs	sben	bens	sben
13.	*begged*	begd	dgbe	begd	dgbe	begd	dgbe
14.	*begs*	begs	sgbe	begs	sgbe	begs	sgbe
15.	*blast*	blast	təs.lap	blast	təs.lap	blast	təs.lab
16.	*bled*	bled	dleb	bled	dleb	bled	dleb
17.	*bloom*	blum	lumb	blum	lumb	blum	lumb
18.	*blunt*	blʌnt	tə.lʌmb	blʌnt	tə.lʌmb	blʌnt	tə.lʌmb
19.	*blur*	bə.ləː	ləb	bə.ləː	ləb	bə.ləː	ləb
20.	*brief*	bɹiːf	fɹiːp	bɹiːf	fɹiːb	bɹiːf	fɹib
21.	*Britain*	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	tən.ɹib
22.	*bronze*	bɹɒns	sbɹon	bɹanz	zɹamb	bɹonz	zɹomb

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	diub	biud	dbiu	biud	diub
24.	*bulb*	bʌub	bʌub	bʌub	bʌub	bʌub	bʌub
25.	*bulbs*	bʌubs	sbʌub	bʌbs	sbʌb	bʌubs	sbʌub
26.	*cashback*	kæʃ.bæk	kə.bæ.ʃi.kæ	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	kə.bæ.ʃi.kæ
27.	*clarify*	kə.læ.ɹi.fai	fai.ɹi.læk	kə.læ.ɹi.fai	fai.ɹi.læk	kə.læ.ɹi.fai	fai.ɹi.læk
28.	*Clark*	kla:k	kla:k	kə.la:k	kə.la:k	kə.la:k	kə.la:k
29.	*clear*	kə.liə	liək	kə.liə	liə.kə	kə.liə	liək
30.	*cliff*	kə.lif	flik	kə.lif	flik	kə.lif	flik
31.	*close*	kə.lous	slouk	kə.lous	slouk	kə.lous	slouk
32.	*closure*	kə.lou.ʃə	ʃə.lou.kə	kə.lou.ʃə	ʃə.lou.kə	kə.lou.ʃə	ʃə.lou.kə
33.	*clothing*	kə.lou.θiŋ	θiŋ.lou.kə	kə.lou.θiŋ	θiŋ.louk	kə.lou.θiŋ	θiŋ.louk
34.	*clubbed*	kə.lʌbd	dblʌk	kə.lʌbd	dbklʌ	kə.lʌbd	dblʌk
35.	*Constantine*	kon.sden.tin	tin.dens.kon	kon.sden.tin	tin.dens.kon	kon.sden.tin	tin.dens.kon
36.	*corpse*	kops	spkoː	kops	spkoː	kops	spko
37.	*crawl*	kɹol	ɹouk	kɹoː	ɹok	kɹoː	ɹok
38.	*crisp*	kɹisp	pəs.kɹi	kɹisp	pəs.kɹi	kɹisp	pəs.ɹik
39.	*crow*	kɹou	ɹouk	kɹou	ɹouk	kɹau	ɹauk
40.	*crown*	kɹaŋ	ɹaŋk	kɹaŋ	ɹaŋk	kɹaŋ	ɹaŋk
41.	*cry*	kə.ɹai	ɹaik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kiub	bkiu	kiup	bkiu	kiup	bkiu
43.	*digest*	dʌi.dʒest	təs.dʒe.dʌi	dʌi.dʒest	təs.dʒe.dʌi	dʌi.dʒest	təs.dʒe.dʌi
44.	*disband*	dis.bend	bend.dis	dis.ben.də	də.bens.di	dis.bend	də.bens.di
45.	*disclaim*	dis.klem	lem.kəs.di	dis.klem	klem.sdi	dis.klem	lem.kəs.di

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	sgʌ.sdi	dis.gʌs	sgʌ.sdi
47.	*dumped*	dʌmpt	təp.dʌm	dʌmpt	tpdʌm	dʌmpt	tpdʌm
48.	*east*	ist	təs.i	ist	təs.i	ist	ts.i
49.	*eats*	its	ts.i	its	ts.i	its	ts.i
50.	*Ed*	ed	de	ed	d.e	ed	d.e
51.	*edge*	eddʒ	dʒid.e	eddʒ	dʒd.e	eddʒ	dʒd.e
52.	*elf*	elf	fel	elf	f.el	elf	f.el
53.	*else*	els	s.el	els	s.el	els	s.el
54.	*elves*	elfs	sf.el	elfs	sf.el	elfs	sf.el
55.	*encourage*	iŋ.kʌ.ɹi.dʒy	dʒi.ɹi.kʌ.in	iŋ.kʌ.ɹitʃ	dʒi.ɹi.kʌ.in	in.ka.ɹidʒ	dʒi.ɹi.kʌ.iŋ
56.	*encouraging*	iŋ.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹi.kʌ.in	iŋ.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	iŋ.kʌ.ɹi.dʒin	dʒin.ɹi.kʌ.in
57.	*English*	iŋ.gə.li.ʃi	ʃi.li.gə.iŋ	iŋg.liʃ	ʃi.li.gə.iŋ	iŋg.liʃ	ʃi.li.gə.iŋ
58.	*ex-con*	eks.kon	kon.eks	eks.koŋ	koŋs.e	eks.koŋ	koŋks.e
59.	*excuse*	is.kius	kius.iks	is.gius	sgiu.iks	is.gius	sgius.i
60.	*exhale*	eks.hel	hels.kə.e	eks.hel	helks.i	iks.heu	helks.i
61.	*explode*	iks.ploud	dlou.pə.iks	iks.bloud	de.lou.bə.iks	iks.bloud	də.loub.iks
62.	*fabric*	fe.bɹik	kə.bɹi.fe	fe.bɹik	kə.bɹi.fe	fe.bɹik	kə.bɹi.fe
63.	*fact*	fækt	tək.fæ	fækt	tək.fæ	fækt	tkfæ
64.	*famed*	femd	dfem	femd	dfem	femd	dfem
65.	*fed*	fed	def	fed	dfeː	fed	def
66.	*film*	fium	milf	fium	m.fiu	fium	m.fiu
67.	*fish*	fiːʃ	ʃfiː	fiʃ	ʃfiː	fiʃ	ʃfi
68.	*flap*	flæ.pə	pə.læf	flæp	pə.læf	flæp	plæf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flət	tə.ləf	flət	tə.ləf	flət	tə.ləf
70.	*flu*	fluː	luf	fluː	luf	fluː	luf
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	ʃi.li.fu	fu.liʃ	ʃi.li.fu	fu.li.ʃy	ʃi.li.fu
73.	*frank*	fɹenk	kə.ɹenf	fɹenk	kfɹen	fɹenk	kə.ɹenf
74.	*Franks*	fɹenks	skə.fɹen	fɹenks	skfɹen	fɹenks	skɹenf
75.	*free*	fɹi	ɹif	fɹi	ɹif	fɹiː	ɹif
76.	*freshness*	fɹeʃ.nis	nis.ʃi.fɹe	fɹeʃ.nis	sni.ʃi.fɹe	fɹe.ʃi.nis	sni.ʃi.fɹe
77.	*friend*	fɹend	də.ɹenf	fɹend	də.ɹenf	fɹend	də.ɹenf
78.	*fringe*	fɹiŋdʒ	dʒɹinf	fɹiŋdʒ	dʒɹiŋf	fɹiŋtʃ	dʒɹinf
79.	*games*	gems	sgem	gems	sgem	gems	sgem
80.	*gasped*	ges.pə.tə	tə.pəs.ge	gespt	təps.ke	gespt	tpsge
81.	*gasps*	gæsps	spsgæ	gæs.pəs	spəs.gæ	gæs.pəs	spəs.gæ
82.	*gave*	geif	veig	geif	fgei	geif	fgei
83.	*glue*	gluː	luːg	gluː	lug	gluː	lug
84.	*grab*	gɹeb	bɹeg	gɹeb	bə.gɹe	gɹeb	bɹeg
85.	*grant*	gɹent	tə.ɹeng	gɹent	tgɹen	gɹent	tə.ɹeng
86.	*grape*	gɹeip	pə.ɹeig	gɹeip	pə.gɹei	gɹeip	pə.ɹeig
87.	*help*	help	pə.hel	help	phel	help	phel
88.	*helped*	helpt	təp.hel	helpt	təp.hel	helpt	tphel
89.	*hobnob*	hob.nop	bə.no.bə.hə	hob.nob	bə.no.bə.ho	hob.nop	bə.no.bə.ho
90.	*implore*	im.ploː	lop.im	im.pə.loə	loə.pə.im	im.pə.lou.ə	loə.pə.im
91.	*improve*	im.pluf	v.plu.im	im.pluf	v.plu.im	im.pluf	fu.lu.pə.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	iŋtʃ	tʃiŋ	iŋtʃ	tʃ.iŋ	iŋtʃ	tʃ.iŋ
93.	*increasing*	iŋ.kɹi.siŋ	siŋ.kɹi.iŋ	iŋ.kɹi.siŋ	siŋ.kɹi.iŋ	iŋ.kɹi.siŋ	siŋ.kɹi.iŋ
94.	*indefinite*	in.de.fi.nit	nit.fiː.de.in	in.de.fi.nit	tə.ni.fi.de.in	in.de.fi.nit	tə.ni.fi.de.in
95.	*independent*	in.di.pen.dənt	tə.dem.pen.di.in	in.di.pen.dənt	tə.dem.pen.di.in	in.di.pen.dənt	tə.dem.pen.di.in
96.	*inflict*	in.fli.kə.tə	tə.fli.kə.iŋ	in.flikt	tə.likf.in	in.flikt	tə.kə.lif.in
97.	*infuse*	in.fius	sz.fiu.in	in.fius	sz.fiu.in	in.fius	sfiu.in
98.	*ink*	iŋk	kiŋ	iŋk	k.iŋ	iŋk	k.iŋ
99.	*inked*	iŋkt	tə.kə.iŋ	iŋkt	tək.iŋ	iŋkt	tk.iŋ
100.	*inks*	iŋks	skiŋ	iŋ.kəs	sk.iŋ	iŋks	sk.iŋ
101.	*instinct*	ins.tiŋ.kə.tə	tə.kə.tiŋs.in	iŋs.tiŋkt	tə.kə.tiŋs.iŋ	ins.tiŋ.kə.tə	tə.kə.tiŋs.iŋ
102.	*instrument*	ins.tɹu.mənt	tə.men.tɹus.iŋ	iŋs.tɹu.mənt	tə.men.tɹus.iŋ	iŋs.tɹu.mənt	tə.men.tɹus.iŋ
103.	*i-Tunes*	ʌi.tuns	tuns.ʌi	ʌi.tuns	stun.ʌi	ʌi.tuns	stun.ʌi
104.	*jasmine*	dʒes.min	mins.dʒe	dʒʌs.min	mins.dʒe	dʒes.min	mins.dʒe
105.	*jumps*	dʒʌm.pəs	spdʒʌm	dʒʌmps	spdʒʌm	dʒʌmps	spdʒʌm
106.	*kept*	kept	təp.keː	kept	tpke	kept	tpke
107.	*lapse*	læ.pəs	splæ	leps	sple	læps	splæ
108.	*lapsed*	lepst	təs.lep	lepst	təs.ple	lepst	təs.ple
109.	*larks*	laks	sklaː	laːks	sklaː	laks	sklaː
110.	*lend*	lend	dlen	lend	dlen	lend	dlen
111.	*lift*	lift	təf.li	lift	təf.li	lift	təf.liː
112.	*lisp*	lisp	pəs.liː	lisp	pəs.liː	lisp	pəs.liː
113.	*lived*	lifd	də.vi.li	lifd	dəf.li	lifd	dəf.liː
114.	*lives*	laifs	sflai	laifs	sflai	laifs	sflai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	kə.loː	lok	klo	lok	klo
116.	*log*	log	goː	log	glo	log	glo
117.	*lump*	lʌmp	plʌm	lʌmp	plʌm	lʌmp	plʌm
118.	*matched*	mætʃt	tətʃ.mæ	mætʃt	tətʃ.mæ	mætʃt	tətʃ.mæ
119.	*melt*	melt	tə.mel	melt	tə.mel	melt	tə.mel
120.	*milk*	milk	kmil	milk	kmil	milk	kmil
121.	*misquote*	mis.ko.wot	tə.kwos.mi	mis.kot	tə.kos.mi	mis.kot	tə.kos.mi
122.	*ounce*	aŋs	s.aŋ	aŋs	s.aŋ	aŋs	s.aŋ
123.	*owns*	oŋs	s.oŋ	oŋs	s.oŋ	oŋs	s.oŋ
124.	*ox*	oks	skoː	oks	kəs.oː	oks	sk.oː
125.	*participate*	pʌ.ti.si.peit	tə.pei.si.ti.pʌ	pʌ.ti.si.peit	tə.pei.si.ti.pʌ	pʌ.ti.si.peit	tə.pei.si.ti.pʌ
126.	*peacemaking*	pis.mei.kiŋ	kiŋ.mei.sz.pi	pis.mei.kiŋ	kiŋ.meis.pi	pis.mei.kiŋ	kiŋ.meis.pi
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	sfʌp	pʌfs	sfpʌ	pʌfs	szf.pʌ
131.	*raised*	ɹeist	dəs.ɹei	ɹeist	təs.ɹei	ɹeist	təs.ɹei
132.	*range*	ɹentʃ	dʒɹen	ɹentʃ	dʒɹen	ɹendʒ	dʒɹen
133.	*recommend*	ɹe.kə.mənd	də.men.kə.ɹe	ɹe.kəm.mend	də.men.kən.ɹe	ɹi.ko.mend	də.men.kon.ɹi
134.	*recruiter*	ɹi.kɹu.tə	tə.ɹu.kə.ɹi	ɹi.kɹu.tə	tə.kɹu.ɹi	ɹi.kɹu.tə	tə.ɹu.kə.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	pə.ʃi.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	pə.ʃi.ʃən.lei.ɹi
137.	*representative*	ɹi.pɹe.zən.tə.tif	tif.tə.zəm.pɹe.ɹi	ɹi.pɹe.sən.tə.tif	tif.tə.zəm.pɹe.ɹi	ɹi.pɹe.zən.tə.tif	tif.tə.zəm.pɹe.ɹi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	təʃ.ɹʌ	ɹʌʃt	tʃɹʌ	ɹʌʃt	tʃɹʌ
139.	*scratch*	sgɹetʃ	tʃi.ɹeks	sgɹetʃ	tʃi.gɹes	sgɹetʃ	tʃgɹes
140.	*scree*	skɹiː	ɹiks	skɹiː	kɹis	skɹiː	gɹis
141.	*segment*	seg.ment	ment.sek	seg.ment	tə.mən.gə.se	seg.ment	tə.men.gə.se
142.	*senseless*	sen.sz.lis	lis.sə.sen	sens.lis	slis.sen	sens.lis	sli.sz.sen
143.	*sequence*	si.kwəns	skwən.si	si.kwens	skwen.si	si.kwens	skwən.si
144.	*shameless*	ʃem.lis	lis.ʃem	ʃem.lis	sli.ʃem	ʃem.lis	sli.ʃem
145.	*shelve*	ʃelf	velʃ	ʃelf	vʃel	ʃelf	fʃel
146.	*shelved*	ʃelfd	dəf.ʃel	ʃelfd	dəf.ʃel	ʃelfd	dəf.ʃel
147.	*skate*	sgeit	tə.geis	sgeit	tə.geis	sgeit	tə.geis
148.	*skating*	sgei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis
149.	*slope*	sloup	pə.lous	sloup	plous	sloup	pə.lous
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuθ	θmus	smuf	fmus	smuf	fmus
152.	*snatch*	snetʃ	tʃnes	snetʃ	tʃnes	snetʃ	tʃnes
153.	*spa*	sbaː	baːs	sbaː	baːs	sba	bas
154.	*spare*	sbeə	beəs	sbeə	beəs	sbeə	beəs
155.	*sphere*	sfiə	fiəs	sz.fiə	fiəs	sfiə	fiəs
156.	*spiritual*	sbi.ɹi.tʃə	tʃə.ɹi.bis	sbi.ɹi.tʃə	tʃə.ɹi.bis	sbi.ɹi.tʃə	tʃə.ɹi.bis
157.	*splendid*	sblen.did	did.lem.bəs	sblen.did	did.lem.bəs	sblen.did	did.lem.bəs
158.	*split*	sblit	tli.bəs	sblit	tlibs	sblit	tə.li.bəs
159.	*spoil*	sboil	boils	sboiə	boiəs	sboi	bois
160.	*spray*	sbɹei	ɹeips	sbɹei	ɹeibs	sbɹei	ɹeibs

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	ɹimps	sbɹiŋ	bɹiŋs	sbɹiŋ	ɹimbs
162.	*springs*	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs
163.	*squeeze*	sgwis	sgwis	sgwis	sgwis	sgwiz	zgwis
164.	*stain*	sdein	deŋs	sden	dens	sden	dens
165.	*star*	sdaː	daːs	sdaː	das	sdaː	das
166.	*string*	sdʒiŋ	dʒiŋs	sdʒiŋ	dʒiŋs	sdʒiŋ	dʒiŋs
167.	*stupid*	sdiu.pid	pid.dius	sdiu.bid	də.bi.dius	sdiu.bid	də.bi.dius
168.	*suppose*	sə.pous	sz.pou.sə	sə.pous	spou.sə	sə.pous	spou.sə
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tekst	təks.te	tekst	tekst	tekst	tkste
171.	*thankful*	θeŋ.kə.fəu	fəu.kə.θeŋ	θeŋk.fəu	fəuk.θeŋ	θeŋk.fəu	fəuk.θeŋ
172.	*trenched*	tʃentʃd	tʃit.tʃen	tʃentʃt	tətʃ.tʃen	tʃentʃt	ttʃtʃen
173.	*tweet*	twit	twit	twit	twit	twit	twit
174.	*underpaid*	ʌn.də.peit	deip.dəɹ.aŋ	ʌn.də.peid	də.pei.də.aŋ	an.də.peid	də.pei.də.aŋ
175.	*understand*	ʌn.də.sden	sden.də.ʌn	aŋ.də.sdend	də.dens.də.an	ʌn.də.sden.də	də.dens.də.ʌn
176.	*urge*	ətʃ	dʒiə	əːdʒ	dʒ.əː	əːtʃ	tʃ.əː
177.	*Welsh*	welʃ	ʃwel	welʃ	ʃwel	welʃ	ʃwel
178.	*whereabout*	weə.ə.baut	ə.baut.weə	weə.ə.baut	tə.bau.ə.eə.wə	weə.ə.baut	tə.baut.ə.weə
179.	*wolf*	wuːf	fv.wuː	wuəf	f.woː	wulf	f.woː
180.	*woodland*	wud.lend	lend.wud	wud.lend	də.len.də.wu	wud.lend	də.len.də.wu

III. GZ-F-23-02 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	dfɹei.ə	ə.fɹeit	də.fɹei.ə	ə.fɹeit	də.fɹei.ə
2.	*age*	eitʃ	tʃə.ei	eitʃ	tʃ.ei	eitʃ	dʒei
3.	*Alps*	elps	sp.el	elps	spel	elps	sp.eu
4.	*amuse*	ə.mius	smiu.ə	ə.mius	smiu.ə	ə.mius	smiu.ə
5.	*anguish*	en.gwiʃ	ʃgu.en	æŋ.gwiʃ	ʃgu.en	æŋ.gwiʃ	ʃgu.en
6.	*anklet*	en.klit	tə.li.kə.en	æŋ.klit	tə.li.kə.en	æŋ.klet	tə.lek.kə.en
7.	*ant*	ent	ten	ent	ten	ent	ten
8.	*approve*	ə.pɹuːf	f.pɹu.ə	ə.pɹuːf	f.pɹu.ə	ə.pɹuːf	f.pɹu.ə
9.	*ask*	ask	kəs.aː	ask	kəs.a	aːsk	kəs.aː
10.	*asked*	askt	də.kəs.aː	askt	də.kəs.a	askt	də.kəs.a
11.	*asks*	asks	sks.a	asks	sks.a	asks	sks.a
12.	*bangs*	bæns	sbæn	bæŋs	sbæŋ	bæŋs	sbæŋ
13.	*begged*	bekt	tkbe	bekt	dgbe	bekt	tkbe
14.	*begs*	beks	skbe	bekts	tskbe	bæks	skbæ
15.	*blast*	blaːst	təs.laːp	blaːst	təs.blaː	blaːst	təs.blaː
16.	*bled*	blet	dlep	blet	dlep	blet	dlep
17.	*bloom*	blum	lump	blum	lump	bluːm	luːmp
18.	*blunt*	blʌnt	tə.lʌmp	blənt	tə.ləmp	blʌnt	tə.lʌmp
19.	*blur*	bləːɹ	ləːɹp	bləːɹ	ləːɹp	bluː	luːp
20.	*brief*	bɹif	fɹip	bɹiːf	fbɹiː	bɹiːf	fbɹiː
21.	*Britain*	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi
22.	*bronze*	bɹants	tsbɹan	bɹonts	tsbɹon	bɹonts	tsbɹon

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	tbiu	biud	diup	biut	tbiu
24.	*bulb*	boup	boup	boup	boup	boup	boup
25.	*bulbs*	bʌlps	sbʌlp	boups	spbou	boups	spbou
26.	*cashback*	kaʃ.bæk	kə.bæʃ.kæ	kaʃ.bæk	kə.bæʃ.kæ	kaʃ.bæk	kə.bæʃ.kæ
27.	*clarify*	klæ.ɹi.fai	fai.ɹi.klæ	klæ.ɹi.fai	fæ.ɹi.klai	klæ.ɹi.fai	fai.ɹi.klæː
28.	*Clark*	klaːk	klaːk	klak	klak	klak	klak
29.	*clear*	kliəɹ	ɹə.kliː	kliəɹ	ɹə.kliː	kliəɹ	ɹə.kliː
30.	*cliff*	klif	flik	klif	fkli	klif	fkli
31.	*close*	klous	sklou	klous	sklou	klous	sklou
32.	*closure*	klou.zə	sə.klou	klou.səɹ	sə.klou	klou.səɹ	sə.klou
33.	*clothing*	klou.θiŋ	θiŋ.louk	klou.θiŋ	θiŋ.louk	klou.θiŋ	θiŋ.klou
34.	*clubbed*	klʌpt	d.bə.klʌp	klʌpt	tpklʌ	klʌpt	tpklʌp
35.	*Constantine*	kons.tən.tin	tin.tən.skon	kons.tən.tin	tin.tən.skon	kons.tən.tin	tin.tən.skon
36.	*corpse*	kops	spkoː	kops	spkoː	kops	spkoː
37.	*crawl*	kɹoː	ɹoːk	kɹoː	ɹoːk	kɹau	ɹauk
38.	*crisp*	kɹisp	pəs.kɹi	kɹisp	pəs.kɹi	kɹisp	pəs.kɹi
39.	*crow*	kɹou	ɹouk	kɹau	ɹauk	kɹau	ɹauk
40.	*crown*	kɹan	ɹank	kɹoːŋ	ɹoːŋk	kɹaŋ	ɹaŋk
41.	*cry*	kɹai	ɹaik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kiup	pkiu	kiup	bkiu	kiup	bkiu
43.	*digest*	dʌi.dʒest	tsdʒe.dʌi	dʌi.dʒest	təs.dʒe.dʌi	dʌi.dʒest	tsdʒe.dʌi
44.	*disband*	dis.bent	də.bens.di	dis.bent	də.bens.di	dis.bent	dben.sdi
45.	*disclaim*	dis.kleim	leim.kəs.di	dis.kleim	kleim.sdi	dis.kleːm	kleim.sdi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	sgʌ.sdi	dis.gʌs	sgʌ.sdi	dis.gʌs	sgʌ.sdi
47.	*dumped*	dʌmpt	tpdʌm	dʌmpt	dpdʌm	dʌmpt	də.pə.dzʌm
48.	*east*	iːst	ts.iː	iːst	tsiː	iːst	təs.iː
49.	*eats*	its	ts.i	its	ts.i	its	ts.i
50.	*Ed*	et	de	æt	dæ	æt	dæ
51.	*edge*	etʃ	tʃ.e	etʃ	tʃ.e	etʃ	tʃ.e
52.	*elf*	elf	fel	elf	fel	elf	fel
53.	*else*	els	s.el	els	sel	els	s.el
54.	*elves*	elfs	sf.el	elfs	sf.el	elfs	sf.el
55.	*encourage*	in.kə.ɹitʃ	dʒi.ɹi.kə.in	in.kə.ɹitʃ	dʒi.ɹi.kə.in	in.kə.ɹitʃ	dʒi.ɹei.kə.in
56.	*encouraging*	in.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	iŋ.kə.ɹi.dʒiŋ	dʒiŋ.ɹi.kə.in	iŋ.kə.ɹi.dʒiŋ	dʒiŋ.ɹei.kə.in
57.	*English*	iŋg.liʃ	ʃli.gə.iŋ	iŋg.liʃ	ʃlig.iŋ	iŋg.liʃ	ʃli.gə.iŋ
58.	*ex-con*	eks.kon	kon.se	eks.kon	kon.eks	eks.kon	kon.se
59.	*excuse*	iks.kius	skius.ik	eks.kius	skiu.eks	eks.kius	skiu.se
60.	*exhale*	iks.hel	hel.se	iks.hail	hai.o.se	eks.hel	hel.eks
61.	*explode*	eks.blout	də.blou.sik	eks.blout	də.blou.iks	eks.blout	də.blou.sik
62.	*fabric*	fæ.bɹik	kə.bɹi.fæː	fæ.bɹik	kə.bɹi.fæː	fæ.bɹik	kə.bɹi.fæː
63.	*fact*	fækt	tkfæ	fækt	tkfæ	fækt	tkfæ
64.	*famed*	feimt	də.feim	feimt	də.feim	feimt	dfeim
65.	*fed*	fet	def	fet	def	fet	dfe
66.	*film*	fium	mf	fium	məf	fium	məɹf
67.	*fish*	fiʃ	ʃfi	fiʃ	ʃfi	fiʃ	ʃfi
68.	*flap*	flæp	plæf	flæp	pflæ	flæp	pflæ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	fləɹt	tləɹf	fləɹt	tləɹf	fləɹt	tfləɹ
70.	*flu*	flu	luf	flu	luf	fluː	luːf
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	ʃli.fu	fu.liʃ	ʃə.lə.fu	fu.liʃ	ʃli.fuː
73.	*frank*	fɹenk	kfɹen	fɹeŋk	kfɹen	fɹeŋk	kfɹen
74.	*Franks*	fɹeŋks	skfɹen	fɹeŋks	skfɹen	fɹeŋks	skfɹen
75.	*free*	fɹiː	ɹiːf	fɹiː	ɹiːf	fɹiː	ɹiːf
76.	*freshness*	fɹeʃ.nis	sniʃ.fɹe	fɹeʃ.nis	sniʃ.fɹe	fɹeʃ.nis	sniʃ.fɹe
77.	*friend*	fɹent	də.ɹenf	fɹent	tfɹen	fɹent	dfɹen
78.	*fringe*	fɹintʃ	dɹinf	fɹintʃ	tʃfɹin	fɹintʃ	dʒfɹin
79.	*games*	gems	sgem	gems	sgem	gems	sgem
80.	*gasped*	gæspt	də.pəs.gæ	gæspt	də.pəs.gæ	gæspt	də.pəs.gæ
81.	*gasps*	gæsps	spsgæ	gæsps	spsgæ	gæsps	spsgæ
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	gluː	luːk	gluː	luːk	gluː	luːk
84.	*grab*	gɹep	bɹek	gɹep	bə.gɹe	gɹep	pgɹe
85.	*grant*	gɹent	tgɹen	gɹent	tgɹen	gɹʌnt	tgɹʌn
86.	*grape*	gɹeip	pə.ɹeik	gɹeip	pə.gɹei	gɹeip	pgɹei
87.	*help*	help	pə.hel	help	phel	help	phel
88.	*helped*	helpt	dəp.hel	helpt	dəp.hel	helpt	də.pə.hel
89.	*hobnob*	hop.nop	pə.no.pə.ho	həp.nop	bə.no.bə.hət	həp.nop	bə.no.bə.hʌt
90.	*implore*	im.plo	plo.im	im.ploːɹ	ploː.im	im.ploː	ploː.in
91.	*improve*	im.pɹuf	fv.pu.in	im.pɹuf	fu.pɹu.in	im.pɹuf	fpɹu.in

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃ.in	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	iŋ.kɹi.siŋ	siŋ.kɹi.in	iŋ.kɹi.siŋ	siŋ.kɹi.in	iŋ.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fi.nit	tə.ni.fi.den.in	in.de.fi.nit	tə.ni.di.fe.in	in.de.fi.nit	tə.ni.fi.de.in
95.	*independent*	in.di.pen.dənt	tə.dəm.pen.di.in	in.di.pen.dənt	tə.dəm.pen.di.in	in.di.pen.dənt	tə.dəm.pen.di.in
96.	*inflict*	in.flikt	tkfli.in	in.flikt	tə.kə.flek.in	in.flikt	tə.kə.flek.in
97.	*infuse*	in.fius	sfiu.in	in.fius	sfiu.in	in.fius	sfiu.in
98.	*ink*	iŋk	kjen	iŋk	kiŋ	iŋk	kiŋ
99.	*inked*	iŋkt	tk.in	iŋkt	dk.in	iŋkt	də.kə.in
100.	*inks*	iŋks	sk.in	iŋks	sk.iŋ	iŋks	sk.iŋ
101.	*instinct*	ins.diŋkt	tə.kə.diŋs.in	ins.diŋkt	tə.kə.diŋs.in	ins.diŋkt	tə.kə.diŋs.in
102.	*instrument*	ins.dɹu.mənt	tə.mən.dɹəs.in	ins.tɹu.mənt	tə.mən.sdɹə.in	ins.tɹə.mənt	tə.mən.tɹəs.in
103.	*i-Tunes*	ai.tuns	styn.ai	ai.tuns	stun.ai	ai.tuns	stun.ai
104.	*jasmine*	dʒæs.min	mins.dʒæ	dʒʌs.min	mins.dʒʌ	dʒeis.min	mins.dʒei
105.	*jumps*	dʒʌmps	spdʒʌm	dʒʌmps	spdʒʌm	dʒʌmps	spdʒʌm
106.	*kept*	kæpt	tpke	kjapt	tə.pə.kæ	kæpt	tpke
107.	*lapse*	læps	splæ	læps	splæ	læps	splæ
108.	*lapsed*	læpst	tslæp	læpst	dəs.plæ	læpst	dəs.plæ
109.	*larks*	laks	skla	laks	skla	laːɹks	skla
110.	*lend*	lent	tlen	lent	tlen	lent	tlen
111.	*lift*	lift	təf.li	lift	təf.li	lift	təf.li
112.	*lisp*	lisp	pəs.li	lisp	pəs.lip	lisp	pəs.li
113.	*lived*	lift	dəf.li	lift	dəf.li	lift	dəf.li
114.	*lives*	laifs	sflai	laifs	sflai	laifs	sflai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	klo	lok	klo	lok	klo
116.	*log*	lok	glo	lok	glo	lok	glo
117.	*lump*	lʌmp	plʌm	lʌmp	pləm	lʌmp	plʌm
118.	*matched*	mætʃt	dətʃ.mæ	mætʃt	dətʃ.mæ	mætʃt	dətʃ.mæ
119.	*melt*	melt	tmel	melt	tmel	melt	tmel
120.	*milk*	milk	kə.mil	miuk	kmiu	milk	kmil
121.	*misquote*	mis.kwout	tə.kwous.mi	mis.kwout	tə.kwous.mi	mis.kwout	tə.kwous.mi
122.	*ounce*	aŋs	s.aŋ	ons	s.on	ons	s.on
123.	*owns*	oŋs	s.oŋ	oŋs	s.oŋ	ons	s.on
124.	*ox*	oks	soː	oks	so	oks	so
125.	*participate*	paɹ.ti.si.peit	tə.pei.si.ti.pa	paɹ.ti.si.peit	tə.pei.si.ti.paɹ	paɹ.ti.si.peit	tə.pei.ti.si.paɹ
126.	*peacemaking*	pis.mek.kiŋ	kiŋ.mek.spiː	pis.mei.kiŋ	kiŋ.meik.spiː	pis.mek.kiŋ	kin.mei.spiː
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	sfpʌ	pʌfs	sfpʌ	pʌfs	sfpʌ
131.	*raised*	ɹeist	tsɹei	ɹeist	dəs.ɹei	ɹeist	dəs.ɹei
132.	*range*	ɹeintʃ	tʃɹein	ɹeintʃ	tʃɹein	ɹeintʃ	dʒɹein
133.	*recommend*	ɹe.kəm.ment	də.men.kən.ɹe	ɹe.kəm.ment	də.men.kən.ɹe	ɹe.kəm.ment	də.men.kəm.ɹe
134.	*recruiter*	ɹi.kɹu.tə	tə.ku.ɹi	ɹi.kɹu.tə	tə.ku.ɹi	ɹi.kɹu.tə	tə.kɹu.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒə.ɹei.təɹ	tə.ɹi.dʒə.fɹi.ɹi	ɹi.fɹi.dʒu.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒu.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	pə.ʃi.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	pə.ʃi.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	pə.ʃi.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.ti.tif	fti.tei.sem.pɹi.ɹe	ɹe.pɹi.sen.tei.tif	f.ti.tei.sem.pɹi.ɹe	ɹe.pɹi.sen.tei.tif	fu.ti.tei.sem.pɹi.ɹe

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	dəʃ.ɹʌt	ɹʌʃt	dəʃ.ɹʌt	ɹʌʃt	dəʃ.ɹʌ
139.	*scratch*	skɹetʃ	tʃkɹes	skɹetʃ	tʃkɹes	skɹetʃ	tʃkɹes
140.	*scree*	skɹiː	kɹiːs	skɹiː	kɹiːs	skɹiː	kɹis
141.	*segment*	seʔ.mənt	mən.tə.se	sek.mənt	tə.mən.gə.se	sek.mənt	tə.mən.gə.se
142.	*senseless*	sens.lis	slis.sen	sens.les	sles.sen	sens.les	sles.sen
143.	*sequence*	si.kwəns	skwən.siː	si.kwəns	skwən.siː	si.kwəns	si.kwən.siː
144.	*shameless*	ʃem.lis	slə.ʃeim	ʃem.lis	sli.ʃem	ʃem.les	sle.ʃem
145.	*shelve*	ʃelf	fʃel	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelft	dəf.ʃel	ʃelft	dəf.ʃel	ʃelft	dəf.ʃel
147.	*skate*	sgeːt	tə.geːs	sgeːt	tə.geːs	sgeit	tgeis
148.	*skating*	sgeː.tiŋ	tiŋ.geːs	sgeː.tiŋ	tiŋ.geːs	sgeː.tiŋ	tiŋ.geːs
149.	*slope*	sloup	plous	sloup	plous	sloup	plous
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuːθ	θmuːs	smuθ	θmus	smuθ	θmus
152.	*snatch*	snetʃ	tʃnes	snetʃ	tʃnes	snetʃ	tʃnes
153.	*spa*	sbaː	baːs	spaː	paːs	spaː	paːs
154.	*spare*	speəɹ	ɹə.pes	sbeəɹ	ɹə.bes	sbeəɹ	ɹə.bes
155.	*sphere*	sfi.əɹ	ɹə.fis	sfiəɹ	ɹə.fis	sfiəɹ	ɹə.fis
156.	*spiritual*	sbi.ɹi.tʃou	tʃou.ɹi.piːs	sbi.ɹi.tʃou	tʃou.ɹi.pis	sbi.ɹi.tʃou	tʃou.ɹi.pis
157.	*splendid*	sblen.dit	də.di.blens	sblen.dit	də.di.blens	sblen.dit	də.di.blens
158.	*split*	sblit	tlips	sblit	tə.blis	split	tə.lips
159.	*spoil*	sboil	boils	sboil	boils	sboil	boils
160.	*spray*	spɹei	pɹeis	spɹei	bɹeis	sbɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs
162.	*springs*	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋts	sbɹiŋs
163.	*squeeze*	skwis	tskwis	skwits	tskwis	sgwits	tskwis
164.	*stain*	sdeŋ	deŋs	sden	dens	sden	dens
165.	*star*	sdaːɹ	daːɹs	sdaɹ	daɹs	sdaːɹ	daːɹs
166.	*string*	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs
167.	*stupid*	sdiu.pit	tə.pi.dius	sdiu.bit	də.pi.dius	sdiu.pit	dpi.dius
168.	*suppose*	səp.pous	spou.sə	səp.pous	spou.sə	səp.pous	spou.sə
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tækst	tə.tæks	tækst	tækst	tækst	tækst
171.	*thankful*	θeŋk.fou	fouk.θen	θeŋk.fou	fouk.θen	θenk.foː	fo.kə.fen
172.	*trenched*	tɹentʃt	t.tɹen	tɹentʃt	dətʃ.tɹen	tɹentʃt	tt͡ʃtɹen
173.	*tweet*	twit	twit	twit	twit	twit	twit
174.	*underpaid*	ʌn.dəɹ.peit	də.pei.dəɹ.ʌn	ʌn.də.peit	dpei.də.ʌn	ʌn.də.peit	dpei.də.ʌn
175.	*understand*	ʌn.dəɹ.sdænt	də.dæn.sdə.ʌn	ʌn.dəɹ.sdænt	də.dæn.sdəɹ.ʌn	ʌn.də.sdænt	də.dæn.sdəɹ.ʌn
176.	*urge*	əːɹtʃ	tʃ.əːɹ	əːɹtʃ	tʃ.əːɹ	əːɹtʃ	tʃ.əːɹ
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃ.wel	welʃ	ʃ.wel
178.	*whereabout*	weə.ə.baut	tə.bau.ə.weː	weə.ə.baut	tə.bau.ə.we	weə.ə.baut	tbau.ə.weə
179.	*wolf*	wof	fwo	woːf	foː	woːf	f.woː
180.	*woodland*	wut.lent	də.len.də.wut	wut.lent	də.len.də.wut	wud.lent	də.len.də.wut

IV. GZ-M-24-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	fɹei.də	ə.fɹeit	fɹeid.ə	ə.fɹeit	fɹeit.ə
2.	*age*	eitʃ	tʃ.ei	eitʃ	tʃ.ei	eitʃ	tʃ.ei
3.	*Alps*	elps	s.elp	elps	s.elp	elps	s.elp
4.	*amuse*	ə.mjus	smju.ə	ə.mjuːs	smju.ə	ə.mjuːs	smju.ə
5.	*anguish*	æŋ.gwiʃ	gwiʃ.æŋ	eŋ.gwiʃ	ʃgwi.en	æŋ.gwiʃ	ʃgwi.en
6.	*anklet*	æŋk.lit	lit.æŋk	æŋk.lit	lit.æŋk	æŋk.lit	lit.æŋk
7.	*ant*	ent	ten	ent	t.en	ent	ten
8.	*approve*	ə.pɹuːf	puf.ə	ə.pɹuːf	fə.pɹu.ə	ə.pɹuːf	pɹuf.ə
9.	*ask*	ask	kə.saː	aːsk	kəs.aː	aːsk	kəs.aː
10.	*asked*	askt	tə.kəs.aː	aːskt	tə.kəs.aː	aːskt	tə.kəs.aː
11.	*asks*	asks	sk.as	aːsks	skəs.aː	aːsks	skəs.aː
12.	*bangs*	bæŋs	sbæŋ	bæŋs	sbæŋk	bæŋs	sbæŋk
13.	*begged*	be.git	gi.bet	be.git	gi.bet	be.git	git.bek
14.	*begs*	beks	sgep	beks	sbek	bæks	sbæk
15.	*blast*	blaːst	təs.lap	blaːst	laːstp	blast	tə.lasp
16.	*bled*	blet	dlep	blet	letp	blet	dlep
17.	*bloom*	blum	luːmb	bluːm	luːmp	bluːm	luːmp
18.	*blunt*	blʌnt	tʌnb	blʌnt	lʌntp	blʌnt	tə.lʌnp
19.	*blur*	bləː	ləːb	bləː	ləːb	bləː	ləːb
20.	*brief*	bɹiːf	fɹiːp	bɹiːf	ɹiːfp	bɹiːf	fbɹiː
21.	*Britain*	bɹi.tən	tən.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi
22.	*bronze*	bɹans	sbɹan	bɹans	sbɹan	bɹans	sbɹan

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biut	diup	biut	diup	biut	diup
24.	*bulb*	bʌup	bʌup	bʌup	bʌup	bʌup	bʌup
25.	*bulbs*	bʌups	sbʌup	bʌups	sbʌub	bʌups	sbʌup
26.	*cashback*	keʃ.bek	be.keʃ	keʃ.bek	gə.beʃ.gə	kæʃ.bæk	bæk.kæʃ
27.	*clarify*	klæ.ɹi.fai	fai.ɹi.klæ	kle.ɹi.fai	flai.ɹi.keː	kle.ɹi.fai	flai.ɹi.keː
28.	*Clark*	klaɹk	klak	kɹaːk	laːk	kɹaːk	klaːk
29.	*clear*	kliə	li.ək	kliə	ə.kliː	kliə	ə.kliː
30.	*cliff*	klif	lifk	klif	fkliː	klif	fkliː
31.	*close*	klous	sklou	klous	sklou	klous	sklou
32.	*closure*	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou	klou.ʃə	ʃə.klou
33.	*clothing*	klou.fiŋ	fiŋ.klou	klou.fiŋ	fiŋ.klou	klou.fiŋ	fiŋ.klou
34.	*clubbed*	klʌ.bit	bit.klʌp	klʌ.bit	bit.klʌp	klʌ.bit	bit.klʌp
35.	*Constantine*	kon.stən.tin	tin.tən.skon	kon.sten.din	tin.ten.skon	kon.sten.tin	tin.ten.skon
36.	*corpse*	koːps	spoːk	koɹps	skoɹp	koɹps	skoɹp
37.	*crawl*	kɹoː	ɹoːk	kɹoː	ɹoːk	kɹoː	ɹoːk
38.	*crisp*	kɹisp	pəs.kɹi	kɹisp	pəs.kɹiː	kɹisp	pəs.kɹiː
39.	*crow*	kɹau	ɹauk	kɹau	ɹauk	kɹau	ɹauk
40.	*crown*	kɹaŋ	aŋkɹ	kɹaun	ɹaŋk	kɹaŋ	ɹaŋk
41.	*cry*	kɹai	ɹaik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kjuːp	bə.kiu	kjuːp	bə.kjuː	kjuːb	bə.kiu
43.	*digest*	dʌi.dʒest	dʒes.dʌi	dʌi.dʒest	dʒest.dʌi	dʌi.dʒest	dʒest.dʌi
44.	*disband*	dis.bent	ben.dis	dis.bend	ben.dis	dis.bent	ben.dis
45.	*disclaim*	dis.kleim	kleim.dis	dis.kleim	kleim.dis	dis.kleim	kleim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌmt	tdʌmp	dʌmt	tdʌmp	dʌmpt	tə.dʌmp
48.	*east*	iːst	tə.siː	iːst	təs.iː	iːst	təs.iː
49.	*eats*	its	ts.iː	iːts	ts.iː	iːts	ts.iː
50.	*Ed*	et	den	et	deː	eːd	deː
51.	*edge*	etʃ	dʒ.et	eːtʃ	tʃ.eː	eːtʃ	dʒ.eː
52.	*elf*	elf	fel	elf	fel	elf	f.el
53.	*else*	els	s.el	els	s.el	els	s.el
54.	*elves*	elfs	s.elf	elfs	s.elf	elfs	s.elf
55.	*encourage*	in.kʌ.ɹitʃ	dʒi.ɹi.kʌ.ən	in.kʌ.witʃ	dʒi.wi.kʌ.in	in.kʌ.ɹitʃ	dʒi.ɹə.kən.in
56.	*encouraging*	in.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹi.kʌ.in	in.ka.ɹi.dʒiŋ	dʒiŋ.ɹi.ka.in	in.ka.ɹi.dʒiŋ	dʒiŋ.wi.ka.in
57.	*English*	iŋg.liʃ	ʃi.li.iŋk	iŋg.liʃ	liʃ.iŋk	iŋg.liʃ	ʃi.li.iŋk
58.	*ex-con*	es.kon	kon.eks	eks.kon	kon.eks	eks.kon	kon.eks
59.	*excuse*	iks.gius	sgiu.iks	iks.gius	sgiu.iks	iks.gius	sgiu.iks
60.	*exhale*	ik.sel	sel.ik	ik.sel	sel.iks	ek.sel	sel.eks
61.	*explode*	iks.blout	blout.iks	iks.blout	də.blou.iks	iks.bloud	blout.iks
62.	*fabric*	fæ.bɹik	ɹik.fæp	fe.bɹik	bɹik.feː	fe.bɹik	bɹik.feː
63.	*fact*	fæːt	tæːf	fæːkt	tæːf	fækt	tə.fæk
64.	*famed*	feimt	də.feim	feimt	də.feim	feimt	də.feim
65.	*fed*	fet	def	fet	def	fet	def
66.	*film*	film	milf	film	milf	film	milf
67.	*fish*	fiʃ	ʃif	fiʃ	ʃfiː	fiʃ	ʃfiː
68.	*flap*	flep	pə.fleː	flæp	læpf	flæp	plæf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flə:t	tə:f	flə:t	tlə:f	flə:t	tlə:f
70.	*flu*	flu	luf	flu:	lu:f	flu:	lu:f
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	ʃi.li.fu:	fu.liʃ	ʃli.fu:	fu.liʃ	ʃi.li.fu:
73.	*frank*	fɹeŋk	ɹeŋkf	fɹenk	kfɹen	fɹenk	kə.fɹen
74.	*Franks*	fɹeŋks	sfɹeŋk	fɹeŋks	sfɹeŋk	fɹeŋks	sfɹeŋk
75.	*free*	fɹi:	ɹif	fɹi:	ɹi:f	fɹi:	ɹi:f
76.	*freshness*	fɹeʃ.nis	sniʃ.fɹe	fɹeʃ.nis	nis.ʃfe	fɹeʃ.nis	nis.feʃ
77.	*friend*	fɹent	den.fɹi	fɹent	ɹendf	fɹent	ɹendf
78.	*fringe*	fɹintʃ	dʒi.fɹin	fɹintʃ	dʒɹinf	fɹintʃ	dʒfɹin
79.	*games*	ge:ms	sge:m	ge:ms	sge:m	ge:ms	sge:m
80.	*gasped*	gespt	spə.də.ge:	gespt	tə.gesp	gespt	tə.pəs.ge
81.	*gasps*	gesps	spə.ges	gesps	spəs.ge:	gjasps	spəs.ge:
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	glu	luk	glu:	lu:g	glu:	lu:g
84.	*grab*	gɹep	bɹek	gɹep	ɹepk	gɹep	ɹepk
85.	*grant*	gɹænt	tə.gɹæn	gɹænt	tə.gɹæn	gɹent	tə.gɹen
86.	*grape*	gɹeip	pə.gɹei	gɹeip	pə.gɹei	gɹeip	pə.gɹei
87.	*help*	help	pel	help	phel	help	pə.hel
88.	*helped*	helpt	tə.help	helpt	tə.help	helpt	thelp
89.	*hobnob*	hob.lob	lop.hop	hop.lop	lop.hop	hop.lop	lop.hop
90.	*implore*	im.plo:	plo.im	im.plo:	plo.im	im.plo:	plo.im
91.	*improve*	im.pɹu:f	pɹuf.im	im.pɹu:f	pɹuf.im	im.pɹu:f	pɹuf.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃ.in	intʃ	tʃ.in	intʃ	tʃ.in
93.	*increasing*	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in	in.kwi.siŋ	siŋ.kwi.in
94.	*indefinite*	in.de.fi.nit	nit.fi.de.in	in.de.fi.nit	nit.fi.de.in	in.dæ.fi.nit	lit.fi.dæ.in
95.	*independent*	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dən.pen.di.in
96.	*inflict*	in.flikt	flik.in	in.flikt	flet.in	in.flikt	flik.in
97.	*infuse*	in.fius	sfiu.in	in.fius	sfiu.in	in.fius	sfiu.in
98.	*ink*	iŋk	kiŋ	iŋk	kiŋ	iŋk	kin
99.	*inked*	iŋkt	t.iŋk	iŋkt	tə.kin	iŋkt	tək.iŋ
100.	*inks*	iŋks	sk.iŋ	iŋks	s.iŋk	iŋks	s.iŋk
101.	*instinct*	in.sdiŋt	sdiŋ.in	ins.diŋt	diŋs.in	ins.diŋt	diŋs.in
102.	*instrument*	ins.tʃə.mən	mən.stʃe.in	ins.tʃə.mən	mən.tʃus.iːn	ins.tʃə.mənt	mən.stʃu.in
103.	*i-Tunes*	ai.tyns	stun.ai	ai.tyns	stun.ai	ai.tyns	stun.ai
104.	*jasmine*	dʒes.min	mins.dʒe	dʒes.min	mins.dʒʌ	dʒʌs.min	mins.dʒʌ
105.	*jumps*	dʒʌms	sdʒʌm	dʒʌms	sdʒʌmp	dʒʌms	sdʒʌmp
106.	*kept*	kæpt	æptk	kjapt	tə.kjap	kjapt	tə.kjap
107.	*lapse*	læps	slæp	læps	slæp	læps	slæp
108.	*lapsed*	læpst	tə.læps	læpst	tə.læps	læpst	təs.læːp
109.	*larks*	laːks	slaːk	laːks	slaːk	laːks	slaːɹk
110.	*lend*	lend	den	lend	dent	lend	den
111.	*lift*	lift	təf.li	lift	təf.liː	lift	təf.liː
112.	*lisp*	lisp	pəs.li	lisp	pəs.liː	lisp	pəs.liː
113.	*lived*	lift	tə.lif	lift	təf.liː	lift	təf.liː
114.	*lives*	laifs	slaif	laifs	slaif	laifs	slaif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	klo	loːk	koː	loːk	kloː
116.	*log*	lok	gok	loːk	goː	loːk	goː
117.	*lump*	lʌmp	pʌm	lʌmp	pʌm	lʌmp	pʌm
118.	*matched*	metʃt	tətʃ.met	metʃt	tətʃ.met	mætʃt	tətʃ.mæt
119.	*melt*	melt	telm	melt	tmel	melt	tmel
120.	*milk*	milk	kilm	miuk	kmiu	milk	kmil
121.	*misquote*	mis.kwout	tə.kwou.mis	mis.kwout	tə.kwous.mi	mis.kwout	tə.kwous.mi
122.	*ounce*	aŋs	s.aŋ	aŋs	s.aŋ	aŋs	s.aŋ
123.	*owns*	oŋs	s.oŋ	oŋs	s.oŋ	oŋs	s.oŋ
124.	*ox*	oks	s.ok	oks	s.ok	oks	s.ok
125.	*participate*	pʌ.ti.si.peit	pei.ti.si.paɹ	paɹ.ti.si.peit	pei.ti.si.paɹ	paɹ.ti.si.peit	pei.si.ti.paɹt
126.	*peacemaking*	pis.mei.kiŋ	kiŋ.meis.piː	pis.mei.kiŋ	kiŋ.meis.pi	pis.mei.kiŋ	kiŋ.meis.piː
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹeː
130.	*puffs*	pʌfs	sfʌp	pʌfs	spʌf	pʌfs	spʌf
131.	*raised*	ɹeist	sɹei	ɹeist	təs.ɹei	ɹeist	təs.ɹei
132.	*range*	ɹeintʃ	dʒɹein	ɹeintʃ	dʒɹein	ɹeintʃ	dʒɹein
133.	*recommend*	ɹe.kəm.ment	men.kən.ɹe	ɹe.km.ment	men.kən.ɹe	ɹe.km.ment	men.kəm.ɹet
134.	*recruiter*	ɹi.kɹu.tə	tə.ku.ɹi	ɹi.kɹu.tə	tə.ku.ɹi	ɹi.kɹu.tə	tə.ku.wi
135.	*refrigerator*	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹei.dʒi.fɹi.ɹi	ɹi.fi.dʒi.ɹei.tə	tə.ɹi.dʒi.fɹi.ɹi	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹi.dʒi.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹi.pɹi.sen.ti.tif	ti.tei.sem.pɹi.ɹi	ɹi.pɹi.sen.tə.tif	ti.tə.sem.pɹi.ɹi	ɹi.pɹi.sen.ti.tif	ti.tə.sem.pi.wi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	təʃ.ɹʌː	ɹʌʃt	təʃ.ɹʌː	ɹʌʃt	təʃ.ɹʌː
139.	*scratch*	skɹetʃ	tʃkwes	skɹetʃ	tʃɹesk	skɹetʃ	tʃkɹes
140.	*scree*	sgɹiː	ɹisk	sgɹiː	ɹiːsk	skɹiː	kɹiːs
141.	*segment*	sek.mən	mən.sek	seʔ.mənt	mən.sek	sek.mənt	mən.sek
142.	*senseless*	sen.sə.lis	lis.sen	sens.lis	lis.sens	sens.lis	lis.sens
143.	*sequence*	si.kwəns	skwən.siː	si.kwəns	skwən.siː	si.kwəns	skwən.siː
144.	*shameless*	ʃeim.nis	lis.ʃeim	ʃeim.lis	lis.ʃeim	ʃeim.lis	lis.ʃeim
145.	*shelve*	ʃelf	felʃ	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelft	təf.ʃel	ʃelft	təf.ʃel	ʃelft	təf.ʃel
147.	*skate*	sgeit	tə.geis	sgeit	tə.geis	sgeit	tə.geis
148.	*skating*	sgei.tiŋ	tiŋ.geis	sgei.tiŋ	tiŋ.geis	sge.tiŋ	tiŋ.geis
149.	*slope*	sloup	plous	sloup	plous	sloup	plous
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuːf	fuːms	smuːf	muːfs	smuːf	fmuːs
152.	*snatch*	slætʃ	tʃlæs	slætʃ	tʃlæs	slætʃ	tʃlæs
153.	*spa*	sbaː	baːs	sbaː	baːs	sbaː	baːs
154.	*spare*	sbeə	eə.bəs	sbeə	beəs	sbeː.ə	ə.beːs
155.	*sphere*	sfiə	fiəs	sfiə	fiəs	sfiə	fiəs
156.	*spiritual*	sbi.ɹi.tʃəl	tʃəl.ɹi.bi.si	sbi.ɹi.tʃəl	tʃəl.ɹi.bis	sbi.ɹi.tʃəl	tʃəl.wi.bis
157.	*splendid*	sblen.dit	dis.blen	sblen.did	dis.blen	sblen.dit	dis.blen
158.	*split*	sblit	lips	sblit	blits	sblit	lips
159.	*spoil*	sboil	boils	sboil	boils	sboil	boils
160.	*spray*	sbɹei	bɹeis	sbɹei	bɹeis	sbɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	ɹiŋsp	sbɹiŋ	ɹiŋsp	sbɹiŋ	ɹiŋsp
162.	*springs*	sbɹiŋ	sɹiŋps	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs
163.	*squeeze*	skwiːs	skwiːs	sgwiːs	sgwiːs	sgwiːs	sgwiːs
164.	*stain*	sdein	deins	sdein	deins	sdein	deins
165.	*star*	sdaːɹ	aːst	sdaː	daːs	sdaːɹ	daːɹs
166.	*string*	sdʒiŋ	dʒiŋs	sdʒiŋ	dʒiŋs	sdʒiŋ	dʒiŋs
167.	*stupid*	sdiu.bit	bi.dius	sdju.bit	bi.djuːs	sdju.bit	pi.djuːs
168.	*suppose*	sə.pous	spou.sə	səp.pous	pous.sʌp	səp.pous	spou.sə
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tekst	tekst	tekst	tekst	tekst	tekst
171.	*thankful*	feŋk.fou	fouk.fen	θeŋ.fou	fouk.fen	fenk.fu	fou.feŋk
172.	*trenched*	tʃentʃt	tə.tʃentʃ	tʃentʃt	tətʃ.tʃen	tʃentʃt	tətʃ.tʃen
173.	*tweet*	twit	wit	twit	wit	twit	twit
174.	*underpaid*	ʌn.də.peit	pei.də.ʌn	ʌn.də.peit	pei.də.ʌn	ʌn.də.peit	pei.də.ʌn
175.	*understand*	ʌn.də.sdent	sden.də.ʌn	ʌn.də.sdent	dens.də.ən	ʌn.də.sdent	sden.də.ʌn
176.	*urge*	əːtʃ	dʒ.əː	əːtʃ	dʒ.əː	əːtʃ	tʃ.əː
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃ.wel	welʃ	ʃ.wel
178.	*whereabout*	weə.ə.baut	bau.tə.ə.weː	weə.ə.baut	ə.bau.ə.we	weə.ə.baut	bau.tə.weə
179.	*wolf*	woːf	foː	woːf	f.woː	woːf	f.woː
180.	*woodland*	wu.lent	len.wut	wu.lent	lent.wuːt	wut.lent	lent.wuːt

V. GZ-M-25-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹeid	fɹeid.ə	ʌ.fɹeit	fɹeid.əː	ʌ.fɹei.də	fɹeid.əː
2.	*age*	eidʒ	tʃ.ei	eidʒ	dʒ.ei	eidʒ	dʒ.ei
3.	*Alps*	æu.ps	ps.eu	eː.ʌu.ps	ps.eː.ʌu	æu.ps	ps.eu
4.	*amuse*	ʌm.mjuːs	mjuːs.ʌː	ʌm.mjuːs	mjuːs.əː	ʌm.mjuːs	mjuːs.əː
5.	*anguish*	æŋ.gwiːʃ	gwiʃ.æŋ	æŋ.gwiʃ	gwiʃ.æn	æŋ.gwiʃ	gwiʃ.æn
6.	*anklet*	æŋ.klit	kli.æn	æŋ.kleit	kliːt.æn	æŋ.kleit	kliːd.æn
7.	*ant*	eːnt	t.eːn	eːnt	t.eːn	ænt	t.eːn
8.	*approve*	ʌ.puːf	puːf.ʌː	ʌ.pɹuːf	pɹuːf.əː	ʌ.puːf	pɹuːf.əː
9.	*ask*	aːsk	sk.aː	aːsk	sk.aː	aːsk	sk.aː
10.	*asked*	aːskt	kt.aːs	aːskt	skt.aːs	aːskt	skt.aːs
11.	*asks*	aːs.ks	kəs.aː	aːs.ks	kəs.aːs	aːs.ks	ks.aːs
12.	*bangs*	bæŋ.ks	ks.bæːŋ	bæŋ.s	spæːŋ	bæːŋg.s	ss.bæːŋ
13.	*begged*	bæː.gi.də	gəd.bæːg	bæː.gi.də	gəd.bæː	bæː.gi.də	gd.bæː
14.	*begs*	bæ.ks	spæg	bæ.ks	ks.bæːt	bæ.ks	ks.bæ
15.	*blast*	blaːst	slaːp	glaːst	st.blaː	blaːst	laːst.b
16.	*bled*	bliː.də	liː.bʏ	dlæd	læd.bə	blæ.də	læ.di.bə
17.	*bloom*	bə.luːm	luːm.bə	bə.luːm	luːm.ba	bʌ.luːm	luːm.bə
18.	*blunt*	blɐnt	tlɐnp	dlʌnt	lʌnt	blʌnt	ləːnt.bə
19.	*blur*	bləː	ləː.bə	bləː	ləː.bə	bləː	ləː.bə
20.	*brief*	bɹiːf	fɹiːb	bɹiːf	ɹiːb	bɹiːf	ɹiːfp
21.	*Britain*	bɹi.tʌn	tʌn.bɹi	bɹiː.tʌn	tʌn.bɹiːt	bɹi.tʌn	tʌn.bɹiːt
22.	*bronze*	bɒns	spoːn	bɒː.nis	spɒːn	bɒːn.s	spɒːn

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	d.biu	biu.də	dʌ.biu	biu.də	dʌ.biu
24.	*bulb*	bɐu.bə	bə.bɐu	bʌu.bə	bʌu.bə	baːp	baːb
25.	*bulbs*	bʌ.ps	s.pab	bʌ.ps	s.pab	baː.ps	spab
26.	*cashback*	kæʃ.bæg	bæk.kæʃ	kæʃ.bæk	bæk.kæʃ	kæːʃ.bæk	bæk.keːʃ
27.	*clarify*	kleː.ɹi.fɹai	fɹai.ɹi.kleː	kleː.ɹi.flai	flai.vi.kleə	kleː.ɹi.flai	flai.ɹi.kleə
28.	*Clark*	klaːk	kə.laː	klaːk	laːk	klaːk	laːk
29.	*clear*	kliː.əː	ni.əː	kliː.əː	liː.əːk	kliː.əː	liː.əːk
30.	*cliff*	kliː.f	f.kliːd	kliː.f	f.kliː	kliː.f	f.kliː
31.	*close*	klou.s	ou.s	klou.s	s.klou	klou.s	s.klou
32.	*closure*	klou.ʃə	ʃə.klou	klou.ʃəɹ	ʃəː.klou	klɒː.ʃiəɹ	ʃəː.klʌu
33.	*clothing*	klou.θeŋ	θiŋ.klou	klou.θeŋ	θeŋ.klʌu	klou.θeŋ	θeŋ.klou
34.	*clubbed*	kləː.pe.də	be.de.klaːp	klaː.bə.də	bə.de.klaːb	klaː.pi.də	bə.de.klaːb
35.	*Constantine*	kɒn.stʌn.tiːn	tiːn.tens.kɒːn	kɒːn.stən.tain	tain.stən.kɒːn	kɒːn.stʌn.tiːn	tiːn.stən.kɒːn
36.	*corpse*	koəps	s.koəb	kwɒp.s	skɹɒp	kɹɒps	ps.kɹɒ
37.	*crawl*	kɹou	ɹʌuk	kɹɒː	lɒː	kɹaːw	ɹauŋk
38.	*crisp*	kwiːpsp	spə.kwiː	kwiːsp	sp.kwiː	kwiːpsp	sp.kwiːp
39.	*crow*	kɹaːw	ɹauk	kɹaːw	ɹauk	kɹaːw	ɹauk
40.	*crown*	kau	awŋk	kɹɒːŋ	o.ɒŋk	kɹau	ɹɒːŋk
41.	*cry*	kɹai	ɹai	kɹaːj	ɹai	kɹaːj	waik
42.	*cube*	kjuːp^h	bə.kjuː	kjuːp^h	bə.kjuː	ki.uːb	bʌ.kjuː
43.	*digest*	dai.ʤes	ʤes.dai	dai.dʒeːst	dʒest.dai	dai.dʒeːst	dʒest.dai
44.	*disband*	dis.bæːn	bæn.des	dis.bæːn	bæːn.dis	dis.bæːn	bæːn.dis
45.	*disclaim*	dis.kleːm	kleːm.dis	dis.kleːm	klem.dis	diːs.klaːm	klaːm.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	diːs.gʌs	gʌs.tis	diːs.gʌs	gʌs.tis	diːs.gʌs	gʌs.tes
47.	*dumped*	dʌm.pt	pt.dʌm	dʌm.pt	pt.dʌm	dʌm.pt	pt.dʌm
48.	*east*	iːst	st.iː	iːst	stʌ.iː	iːst	st.iː
49.	*eats*	iːts	ts.iː	iː.ts	ts.iː	iː.ts	ts.iːt
50.	*Ed*	eː.də	də.eː	æː.də	d.æː	æː.də	dæd
51.	*edge*	eːdʒ	dʒ.eː	æːdʒ	dʒ.æː	æːdʒ	dʒ.eː
52.	*elf*	euf	fu.eu	euf	f.eu	euf	feu
53.	*else*	eː.ʌu.s	s.eː.ʌu.	eː.ʌu.s	s.eː.ʌu.	eː.ʌu.s	s.eː.ʌu.
54.	*elves*	eːw.fs	sf.eːw	eːw.fs	sf.eːw	eːw.fs	fs.eːw
55.	*encourage*	eːŋ.kɾ.ɹetʃ	kaː.ɹitʃ.eːn	eːŋ.kaː.ɹetʃ	kaː.witʃ.eːn	eːŋ.kaː.ɹeːtʃ	kaː.ɹitʃ.eːn
56.	*encouraging*	eːŋ.kɾ.ɹi.dʒeŋ	dʒəm.wi.kɒ.eːn	jiŋ.kaː.ɹi.dʒeŋ	dʒəŋ.ɹi.kaː.iːn	eːŋ.kɾ.ɹe.dʒeŋ	dʒəŋ.kɾɹ.wi.æːn
57.	*English*	eŋ.gə.lʌʃ	ʃi.lʌ.gʌ.eŋ	eŋ.gə.lʌʃ	laʃ.kə.eŋ	eŋ.gə.lʌʃ	ʃ.lʌ.kʌ.eŋ
58.	*ex-con*	eks.kɒn	kɒn.eks	eks.kɒːn	kɒ.neks	eks.kɒːn	kɒːn.eks
59.	*excuse*	eks.kjuːs	gjuːs.eks	eks.kjuːs	gjuːs.eks	eks.kjuːs	gjuːs.eks
60.	*exhale*	eksl.heːw	heːw.eks	eks.hæːw	heːw.eks	eks.heː.ʌu	heːw.eːks
61.	*explode*	eks.plou	blou.eks	eks.plʌus	plʌus.eːks	eks.plau.də	plaud.eːks
62.	*fabric*	fæ.bɹeip	bɹʌk.fæ	fæ.bɹek	bɹek.fæː	fæ.bɹek	bɹek.fæː
63.	*fact*	fæ.t	t.fæ	fæ.kt	kt.fæt	fækt	təː.fæ
64.	*famed*	feim.də	m.dʌ.feːjm	feim.də	m.dʌ.feːjm	feim.də	m.dʌ.feːjm
65.	*fed*	fæː.də	də.fæ	fæː.də	də.fæ	fæː.də	də.fæ
66.	*film*	fium	miːmf	fium	iumf	fliːm	liːmf
67.	*fish*	feiʃ	ʃ.fiː	feiʃ	ʃ.fiː	fiːʃ	ʃ.fiː
68.	*flap*	flæːp	læpf	flæːp	læpf	flæːp	læː.pəf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flə:t	tlə:f	flə:t	tlə:f	flə:t	lə:ft
70.	*flu*	flu:	lu:f	flu:	u:f	flu:	lu:f
71.	*fly*	flai	waif	flai	laif	fla:j	laif
72.	*foolish*	fu:.liʃ	liʃ.fu:	fu:.liʃ	leʃ.fu:	fu:.leʃ	li:ʃ.fu:
73.	*frank*	fɹæŋk	k.fɹæ:n	fɹæŋk	k.fɹæ:n	fɹæŋk	k.fɹæn
74.	*Franks*	fɹæŋ.ks	kəs.fɹæn	fɹæŋ.ks	ks.fɹæ:n	fɹæŋ.ks	kʌs.fɹæ:n
75.	*free*	fɹi:	ɹi:f	fɹi:	ɹi:f	fɹi:	ɹi:f
76.	*freshness*	fɹʌʃ.nis	nis.fɹʌʃ	fɹæʃ.nes	nis.fɹæʃ	fɹæʃ.nes	nis.fɹæʃ
77.	*friend*	fɹen	e:nf	fɹe:n.də	e:n.də	fɹe:n.də	də.fɹe:n
78.	*fringe*	fɹi:ntʃ	tʃu.fɹi:n	fɹi:ntʃ	tʃu.fɹi:n	fɹi:ntʃ	tʃ.fɹi:n
79.	*games*	ge:ms	ske:m	ge:ms	ske:m	ge:ms	ske:m
80.	*gasped*	gja:s.pt	spt.ga:	gja:s.pt	spt.ga:s	gæs.pt	pt.ga:
81.	*gasps*	gasps	sps.ga	gjæp.sps	sps.gaəp	ga:s.ps	sps.ga:
82.	*gave*	geif	f.gei	geif	f.gei	geif	f.gei
83.	*glue*	gʌ.lu:	lu:g	glu:	lu:.gʌ	gʌ.lu:	lu:.gʌ
84.	*grab*	gɹæb	bu.gɹe	gɹæ:.bə	bə.gɹe:	gɹæ:.bə	bu.gɹæ:
85.	*grant*	gɹænt	t.gɹæ:n	gɹæ:nt	t.gɹæ:n	gɹæ:nt	tə.gɹæ:n
86.	*grape*	gɹeip	p.gɹei	gɹeip	p.gɹei	gɹeip	p.gɹei
87.	*help*	heup	p.heu	heup	p.heu	hæup	p.heu
88.	*helped*	heupt	pə.heup	heupt	pt.heu	heupt	pt.heu
89.	*hobnob*	hɒp.nɒb	nɒp.hɒp	hɒp.nɒ:p	nɒp.hɒ:p	hɒp.nɒ:p	nɒ:p.hɒ:p
90.	*implore*	in.plɒ:	plɒ:.im	i:m.plɒ:	plɒ:.im	im.plɒ:	plɒ:.im
91.	*improve*	jim.pɹu:f	pɹu:f.im	jim.ku:f	pɹu:f.im	im.kɹu:f	pɹu:f.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	iːntʃ	tʃ.iːn	iːntʃ	tʃ.iːn	iːntʃ	tʃ.iːn
93.	*increasing*	iːŋ.kwiː.seŋ	seŋ.kɹi.iːn	iːŋ.kɹiː.seŋ	seŋ.kɹiː.iːn	iːŋ.kɹiː.seŋ	seŋ.kɹiː.iːn
94.	*indefinite*	iːn.dæ.fi.nai	nai.fi.di.eːn	iːn.dæ.fi.nʌt	naːʔ.fi.di.iːn	iːn.dæ.fiː.nʌt	nʌf.fi.diː.ein
95.	*independent*	in.di.pæn.dʌn	dʌn.pi.di.iːn	in.di.pæn.dʌn	dʌn.pæn.di.iːn	iːn.diʔ.pæn.dʌn	dʌn.pæn.did.iːn
96.	*inflict*	in.fleːt	flet.iːn	iːn.flit	flit.iːn	iːn.flit	flet.in
97.	*infuse*	in.fjuːs	fjuːs.in	iːn.fjuːs	fjuːs.iːn	iːn.fjuːs	fjuːs.in
98.	*ink*	iŋk	kiŋ	eŋk	keŋ	iːŋk	kiŋ
99.	*inked*	eŋkt	kʌt.eŋ	eŋkt	kt.eŋ	iːŋkt	kt.iŋ
100.	*inks*	iŋks	siŋk	eŋ.ks	ks.eŋ	eŋ.ks	ks.iŋ
101.	*instinct*	iŋ.steŋkt	stiŋkt.eŋ	iːn.steŋkt	steŋ.gt.jin	iːn.steŋkt	steːŋkt.iːn
102.	*instrument*	iːn.sɹʌ.mʌn	mʌn.stɹʌ.iːn	iːn.stɹaʔ.mʌn	mʌn.stɹaʔ.iːn	iːn.stɹaʔ.mʌn	mʌn.stɹaʔ.iːn
103.	*i-Tunes*	ai.tuːns	tuːns.ai	ai.tuːns	tuːns.ai	ai.tuːns	tuːns.ai
104.	*jasmine*	dʒæs.min	min.dʒes	dʒæːs.miːn	min.dʒæːs	dʒæːs.min	miːns.dʒæː
105.	*jumps*	dʒʌm.s	s.tɹʌm	dʒʌm.s	s.dʒʌmp	dʒʌm.s	s.dʒʌm
106.	*kept*	ke.pt	pt.kæ	kæpt	pt.kæ	kæ.pt	pt.kæ
107.	*lapse*	læps	ps.læp	læːps	slæːp	læːps	slæːp
108.	*lapsed*	læpst	st.læːp	læːp.st	st.læːp	læp.seːt	seːt.læp
109.	*larks*	laː.ks	ks.laː	laː.ks	ks.laː	laː.ks	ks.laː
110.	*lend*	læn.də	də.læːn	læn.də	də.læːn	læn.də	dʌ.læːn
111.	*lift*	lift	fliː	liːft	ft.liː	liːft	ft.liː
112.	*lisp*	liːpsp	sp.liː	liːpsp	sp.liːt	liːpsp	sp.liː
113.	*lived*	lejvd	vlei	leift	ft.liː	liːv.də	ft.liː
114.	*lives*	lai.fs	fs.lai	lai.fs	fs.lai	lai.fs	fs.lai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lɒk	klɒ	lɒk	ɒk	lɒk	klɒ
116.	*log*	lɒg	gʌ.lɒː	lɒːg	ɒːg	lɒːg	ɒːg
117.	*lump*	laːmp	pʌm	lʌmp	plʌm	laːmp	pi.lam
118.	*matched*	mætʃ	tʃmæ	mætʃt	tʃt.mæːtʃ	mætʃt	tʃt.mæː
119.	*melt*	meut	tsɨ.meu	mæut	t.mæu	mæut	t.mæu
120.	*milk*	mi.uːk	kə.mjuː	mjuːk	k.mjuː	mjuːk	k.mjuː
121.	*misquote*	mis.kout	kout.mis	mis.kwoːt	kwɒt.miːs	mis.kʌut	kwʌut.mis
122.	*ounce*	aːŋ.s	s.aːŋ	ɒːn.s	s.ɒən	ɒːn.s	s.ɒːn
123.	*owns*	ɒns	s.ɒːn	ɒːns	ts.ɒːn	ɒːns	ts.ɒːn
124.	*ox*	ɒ.ks	sk.ɒ	ɒ.ks	s.ɒː	ɒ.ks	s.ɒː
125.	*participate*	paː.ti.sə.pei	pei.si.ti.paː	paː.ti.si.peit	pei.si.ti.paː	paː.ti.sə.peit	pei.si.ti.paː
126.	*peacemaking*	piːs.me.keŋ	me.kiŋ.piːs	piːs.me.keŋ	me.keŋ.piːs	piːs.me.keŋ	me.keŋ.piːs
127.	*play*	plʌi	leip	plʌi	leip	plʌi	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pəɹ.si.dʌn.siː	siː.dən.si.pəɹ	pɹeː.si.dʌn.siː	siː.dən.si.pɹeː	pɹi.sai.dən.siː	siː.dən.sai.pɹiː
130.	*puffs*	pʌfs	fs.pɐ	pʌfs	spʌf	pu.fs	fs.paː
131.	*raised*	ɹeizd	st.ɹei	ɹeist	st.ɹei	ɹeis.tə	st.ɹeːj
132.	*range*	ɹeːŋdʒ	dʒu.jeːŋ	ɹeːŋdʒ	dʒ.ɹeːŋ	ɹeːŋdʒ	dʒ.ɹeːŋ
133.	*recommend*	ɹʌ.kə.mæːn	kʌ.mem.ɹəː	ɹʌ.kə.mæːnd	mæŋ.kʌn.vəɹ	ɹʌ.kə.mæːnd	mæŋ.kʌ̌.vəɹ
134.	*recruiter*	vi.kuː.təː	tə.kuː.viː	vi.kuː.təː	kuː.tə.viː	wiː.kuː.təː	təː.kuː.viː
135.	*refrigerator*	wiː.fiː.dʒo.ɹei.təː	tʌ.ɹei.dʒuː.fʌ.ɹiː	wiː.fɹiː.dʒəː.ɹei.təː	təː.ɹei.dʒʌ.fɹui.wiː	wiː.fiː.ʒʷʌ.ɹei.təː	təː.wei.dʒʌ.fiː.wiː
136.	*relationship*	wiː.lei.ʃən.ʃiːp	ʃip.ʃʌn.lei.wiː	wiː.lei.ʃən.ʃiːp	ʃip.ʃʌn.lʌi.wiː	wiː.lei.ʃən.ʃiːp	ʃip.ʃʌn.lei.wiː
137.	*representative*	wi.pju.sæn.tə.tiːf	tif.tiː.sæm.pid.ɹiː	wiː.pʷi.sæn.tə.teːf	tif.ti.sæm.pi.ɹiː	wəɹ.pə.sæn.tə.teːf	tif.tei.sæm.pəɹ.vəː

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	ʃt.ɹʌt	ɹʌʃt	ʃt.ɹʌt	ɹaʃt	ʃt.ɹʌt
139.	*scratch*	skwætʃ	tʃ.kwæs	skɹætʃ	gɹæ.tʃs	skɹætʃ	gɹæ.tʃs
140.	*scree*	skwiː	gwiːs	skwiː	gɹiːs	skɹiː	gɹiːs
141.	*segment*	seg.mʌn	mʌn.seg	sæg.mʌnt	mʌnk.seː	sæg.mʌnt	mʌn.sæː
142.	*senseless*	seːns.lʌs	les.sæns	seːns.lʌs	lis.sæns	seːns.lʌs	lis.sæns
143.	*sequence*	siː.kwʌns	kwʌns.siː	siː.kwʌns	kwʌns.siː	siː.kwʌns	kwʌns.siː
144.	*shameless*	ʃeːm.les	les.ʃeim	ʃeim.les	lis.ʃeim	ʃeim.les	les.ʃeim
145.	*shelve*	ʃauf	fʃau	ʃauf	f.ʃaːw	ʃauf	f.ʃau
146.	*shelved*	ʃau.ft	ft.ʃau	ʃauv.də	ft.ʃau	ʃau.ft	ft.ʃaːw
147.	*skate*	skeit	gei.ts	skeit	gei.ts	skeit	geis
148.	*skating*	skei.tiŋ	teŋ.skei	skei.teŋ	teŋ.geis	skei.teŋ	teŋ.skei
149.	*slope*	sloup	loː.ps	sloup	lou.ps	sloup	lou.ps
150.	*small*	smɒː	mɒːs	smoː	moːs	smɒː	mɒːs
151.	*smooth*	smuːf	muːv.s	smuːf	muːv.s	smuːf	muː.fs
152.	*snatch*	snætʃ	tʃnæs	snæːtʃ	næːtʃ.s	snæːtʃ	næːtʃ.s
153.	*spa*	spaː	baːs	spaː	baːs	spaː	baːs
154.	*spare*	speː.a	beː.ʌs	speː.a	beː.ʌs	speː.a	beː.as
155.	*sphere*	sfiː.əː	fiː.ʌs	sfiː.əː	fiː.əːs	sfiː.əː	fiː.əːs
156.	*spiritual*	spi.ɹi.tɹʌu	tɹou.spiː.wiʔ	spi.ɹi.tɹʌu	tɹou.spiː.ɹit	spi.ɹi.tʃwau	tɹʌu.spiː.ɹit
157.	*splendid*	splæn.dəːd	did.splæn	splen.ded	dis.plen	splen.dəd	dis.plen
158.	*split*	split	bli.ts	split	bli.ts	spləːt	bləːd.s
159.	*spoil*	spɒ.jʌu	pɒ.jʌus	spɒ.jʌu	bɒ.jʌus	spɒ.jʌu	bɒ.jʌus
160.	*spray*	spɹei	bɹeis	spɹei	bɹeis	spɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹeŋ	bɹeŋs	spɹeːm	bɹeŋ.s	spɹeːŋ	bɹeːŋs
162.	*springs*	spɹeːŋ.s	spɹeːŋ.s	spɹeːŋ.s	spɹeːŋ.s	spɹeːŋ.s	spɹeːŋ.s
163.	*squeeze*	skwiːs	gwiːs	skwiːds	gwiːs	skwiːs	gwiːs
164.	*stain*	steːn	deːns	steːn	deːns	steːn	deːns
165.	*star*	staː	aːst	staː	aːts	staː	daːs
166.	*string*	stɹeːŋ	dʒweː.ŋist	stɹeːŋ	dʒweːŋs	stɹeːŋ	dʒu.ɹeːŋ.s
167.	*stupid*	stuː.bed	bʌs.tjuː	stjuː.bid	bis.tiu	stuː.bed	duː.bəːs
168.	*suppose*	sʌ.pous	pous.sʌd	sʌ.pous	pous.sʌp	sʌ.pous	pous.sʌd
169.	*swim*	swim	wiː.ms	swiːm	wiː.ms	swiː.m	wiː.ms
170.	*text*	tæst	st.tæ	tæst	tæst	tæst	tæst
171.	*thankful*	θæŋk.fʌu	fouk.fæn	θæŋk.fʌu	fʌu.θæŋk	fæŋk.fʌu	fʌuk.fæːŋ
172.	*trenched*	tʃæntʃt	tʃt.tʃæːn	tʃæntʃt	tʃt.tʃæːn	tʃæntʃt	tʃt.tʃæːn
173.	*tweet*	twiːt	twiːt	twiːt	wiːt	twiːt	twiːt
174.	*underpaid*	ʌn.də.pei	pei.ʌn.də	ʌn.də.pei	pei.ʌn.də	ʌn.də.pei	pei.ʌn.də
175.	*understand*	ʌn.də.stæːn	steːn.ʌn.dəː	ʌn.də.steːnd	steːn.ʌn.dəː	ʌn.də.steːn	steːn.ʌn.dəː
176.	*urge*	əːdʒ	dʒi.ʌ.ɹ	əːdʒ	dʒ.əː	əːdʒ	dʒ.əː
177.	*Welsh*	weuʃ	ʃwæu	wauʃ	ʃ.wau	wauʃ	ʃ.wæu
178.	*whereabout*	weː.ə.bau	ə.bau.weə	weː.ə.bau	ə.bau.weə	weə.ʌ.bau	ə.bau.weə
179.	*wolf*	woːf	f.woː	wɒːf	f.wɒː	wɒːf	f.wɒː
180.	*woodland*	wuʔ.læn	læn.wuʔ	wut.lænd	lænd.wuːd	wud.læːn	læn.wuːd

VI. GZ-M-21-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌ.fɹeid	dei.fə	ə.fɹeid	deif	ə.fɹeit	fɹeid.ə
2.	*age*	eitʃ	dʒei	eitʃ	dʒei	eitʃ	dʒei
3.	*Alps*	ælps	spæl	ælps	s.ælp	ælps	s.ælp
4.	*amuse*	ə.mius	smiu.ə	ə.mius	sə.miu	ə.mius	smiu.ə
5.	*anguish*	en.gyʃ	ʃ.en.gwi	eŋ.gweiʃ	ʃ.eŋ.gwei	eŋ.gwiʃ	ʃ.eŋ.gwi
6.	*anklet*	en.kli	li.ken	en.kli	kli.en	eŋk.lit	lit.enk
7.	*ant*	ent	tæn	ent	ten	ent	teŋ
8.	*approve*	ə.puf	puf.pəɹ	ə.puf	puf.ə	ə.puf	puf.ə
9.	*ask*	ask	sa	ask	kaː	æsk	kæs
10.	*asked*	akst	daː	ækst	desk	æst	də.æks
11.	*asks*	ask	s.ak	ask	sak	aks	sak
12.	*bangs*	bæŋs	sæmb	beŋs	sben	bens	sbeŋk
13.	*begged*	bekt	də.gep	bet	dep	bed	də.be
14.	*begs*	beks	sep	beks	sbek	beks	sbek
15.	*blast*	blæst	slæb	blast	lastp	blæst	læsb
16.	*bled*	blet	lep	blet	dlep	blet	dleb
17.	*bloom*	blun	lumb	blun	lumb	blun	lump
18.	*blunt*	blʌnt	tlʌm	blʌnt	lʌmb	blʌnt	lʌmb
19.	*blur*	bləː	ləːb	bləː	ləːb	bləː	ləːp
20.	*brief*	bɹif	fbɹi	bɹif	fɹib	bɹif	fɹip
21.	*Britain*	bɹi.tin	tim.bɹi	bɹi.tən	təm.bɹi	bɹi.tən	təm.bɹi
22.	*bronze*	bɹonts	dʒomb	bɹonts	tsboŋ	bɹonts	tsbɹoŋ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biu	diub	biud	diub	biu	diu
24.	*bulb*	bʌub	bʌu	bʌub	bʌub	bʌub	bʌub
25.	*bulbs*	bəls	sbəl	bʌus	sbʌu	bʌus	sbʌu
26.	*cashback*	kæʃ.bæk	bæk.kæʃ	kæʃ.bæk	bæ.kæʃ	kæʃ.bæk	bæk.kæʃ
27.	*clarify*	kæ.ɹi.fai	fai.ɹi.keə	kæ.ɹi.fai	fai.ɹi.ke	kæ.ɹi.fai	fai.ɹi.ke.ə
28.	*Clark*	kla:k	kla:k	klak	klak	kla:k	kla:k
29.	*clear*	kliə	liə	kliə	liək	kli.ə	li.ək
30.	*cliff*	klif	flik	klif	flik	klif	flik
31.	*close*	klous	lousk	klous	sklou	klous	lousk
32.	*closure*	klou.ʃə	ʃə:.lok	klou.ʃə	ʃə.kou	klou.ʃə	ʃə:.kou
33.	*clothing*	klou.siŋ	siŋ.klou	klou.θiŋ	θiŋ.klou	klou.siŋ	siŋ.klou
34.	*clubbed*	klʌp	blʌk	klʌpt	dlʌpk	klʌpt	dlʌpk
35.	*Constantine*	kon.stən.tin	tiŋ.stən.kon	kon.stən.tin	tin.stən.kon	kon.stən.tin	tin.stən.kon
36.	*corpse*	ko:ps	sko:	kops	skop	kos	skop
37.	*crawl*	klo	lok	kɹo:	ɹo:k	kɹo:	ɹok
38.	*crisp*	kɹisp	pəs.kwi	kɹisp	pɹik	kwisp	pə.kwis
39.	*crow*	kɹau	ɹauk	kɹou	ɹouk	klou	louk
40.	*crown*	kɹʌn	ɹaŋk	kɹam	ɹank	kɹan	ɹank
41.	*cry*	kwai	aik	kwai	aik	kwai	aik
42.	*cube*	kiub	biuk	kiup	biuk	kiub	biuk
43.	*digest*	dʌi.dʒes	sdʒe.dʌi	dʌi.dʒes	dʒe.dʌi	dʌi.dʒest	dʒe.dʌi
44.	*disband*	dis.bænd	dæm.bə.dis	dis.bæn	bæn.dis	dis.bæn	bæn.dis
45.	*disclaim*	dis.klin	linkst	dis.kliŋ	kliŋ.dis	dis.klei	klei.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌm.məd	də.pʌnd	dʌnd	dʌnd	dʌmd	də.dʌmp
48.	*east*	iːst	tiː	ist	tə.is	ist	tə.is
49.	*eats*	is	s.it	is	siː	is	sit
50.	*Ed*	et	de	et	de	et	de
51.	*edge*	eidʒ	dʒei	etʃ	dʒe	etʃ	dʒe
52.	*elf*	elf	fel	elf	fel	elf	fel
53.	*else*	els	sel	els	s.el	els	s.el
54.	*elves*	elfs	sfel	elfs	s.elf	elfs	s.elf
55.	*encourage*	in.ko.ɹitʃ	ɹitʃ.ko.in	in.kʌ.witʃ	ɹitʃ.in.kʌu	in.kʌ.ɹitʃ	ɹitʃ.in.kʌ
56.	*encouraging*	iŋ.ko.li.dʒiŋ	dʒiŋ.ko.lə.in	iŋ.kʌ.ɹi.dʒwin	dʒwiŋ.ɹi.kʌ.in	iŋ.kʌ.ɹi.dʒin	dʒin.ɹi.kʌ.in
57.	*English*	iŋ.gliʃ	liʃ.iŋ.gə	iŋg.liʃ	liʃ.iŋg	iŋg.liʃ	liʃ.iŋ.gə
58.	*ex-con*	es.kon	kon.es	is.koŋ	koŋ.is	is.koŋ	koŋ.is
59.	*excuse*	is.kius	kiu.is	is.kius	kiu.is	is.kius	kiu.is
60.	*exhale*	is.heu	heu.es	es.hel	hel.eks	es.hel	hel.es
61.	*explode*	is.plout	də.plous	is.blou	blou.is	is.blou	blou.is
62.	*fabric*	fæ.bɹik	kə.bɹi.fə	fɹe.bik	bɹi.fe	fæ.bɹik	bɹik.fɹæ
63.	*fact*	fet	ef	fæt	æf	fet	tef
64.	*famed*	feid	deif	feid	deif	feid	deif
65.	*fed*	fed	def	fed	def	fed	def
66.	*film*	fiu	mil	fiu	iuf	fiu	iuf
67.	*fish*	fiʃ	ʃif	fiʃ	ʃif	fiʃ	ʃif
68.	*flap*	flep	plef	flep	lef	flæp	læf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flʌt	tlʌf	flət	tləf	flət	tləf
70.	*flu*	fluː	luːf	fluː	luf	fluː	luːf
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	liʃ.fuː	fu.liʃ	ʃ.fu.li	fu.liʃ	liʃ.fuː
73.	*frank*	fleŋk	keŋf	fɹeŋk	gɹeŋf	fɹeŋk	kɹeŋf
74.	*Franks*	fleŋks	sfleŋk			fɹens	sfɹeŋk
75.	*free*	fɹiː	ɹif	fɹiː	iːf	fɹiː	iːf
76.	*freshness*	fleʃ.nis	niʃ.fɹe	fɹeʃ.nis	nis.fɹeʃ	fleʃ.nis	nis.fleʃ
77.	*friend*	fɹent	den.ɹif	fɹent	denf	fɹent	deŋf
78.	*fringe*	fɹintʃ	dʒiŋf	fɹintʃ	dʒfin	flintʃ	dʒfɹin
79.	*games*	gems	seŋg	gems	sgem	gems	sgem
80.	*gasped*	gepst	də.gesp	gesp	də.gesp	gest	də.gesp
81.	*gasps*	gæsp	spæk	gesps	speg	geps	sgep
82.	*gave*	geif	feig	geif	fgei	geif	feig
83.	*glue*	gluː	luːg	gluː	luːg	gluː	luːg
84.	*grab*	gɹep	bɹek	gɹep	bɹek	gɹep	bɹek
85.	*grant*	gwent	teng	gɹent	teŋg	gwent	tweng
86.	*grape*	gɹeip	pgɹei	gweip	peik	gweip	pɹeik
87.	*help*	help	pel	help	pel	help	pel
88.	*helped*	helt	del	helt	del	helt	delp
89.	*hobnob*	ho.no	no.ho	ho.no	no.ho	ho.no	no.ho
90.	*implore*	im.ploː	plo.in	im.ploː	plo.in	im.ploː	plo.in
91.	*improve*	im.puf	puf.in	im.puf	puf.in	im.puf	puf.in

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃin	intʃ	tʃin
93.	*increasing*	iŋ.kwi.çiŋ	çiŋ.kwi.in	iŋ.kwi.çiŋ	siŋ.kwi.in	in.kwi.siŋ	siŋ.kwi.in
94.	*indefinite*	in.de.fi.nit	ni.fin.de.in	in.de.fi.nit	ni.fi.de.in	in.de.fi.nit	ni.fi.de.in
95.	*independent*	in.di.pen.dən	dəm.pen.di.in	in.di.pen.dən	dəm.pen.di.in	in.di.pen.dən	dəm.pen.di.in
96.	*inflict*	in.fleikt	t.flei.in	in.flit	tə.fli.in	in.flit	tə.fli.in
97.	*infuse*	in.fius	sə.fiu.in	in.fius	fius.in	in.fius	fius.in
98.	*ink*	iŋk	kə.nin	iŋk	kin	iŋk	kiŋ
99.	*inked*	iŋkt	dkin	iŋkt	diŋk	iŋkt	də.iŋk
100.	*inks*	iŋks	skiŋ	iŋ.kəs	s.iŋk	iŋks	s.iŋk
101.	*instinct*	ins.diŋkt	tiŋs.in	ins.diŋkt	təs.iŋk	ins.dint	təs.din.in
102.	*instrument*	in.stɹu.mən	mən.stɹu.in	in.stɹu.mən	mən.stɹu.in	in.stiu.mən	mən.stiu.in
103.	*i-Tunes*	ʌi.tyns	styn.ʌi	ʌi.tyns	styn.ʌi	ʌi.tyns	tyns.ʌi
104.	*jasmine*	dʒʌs.miŋ	miŋ.dʒʌs	dʒʌs.min	min.sdʒe	dʒʌs.min	min.dʒʌs
105.	*jumps*	dʒʌms	spʌndʒ	dʒʌms	sdʒʌm	dʒʌms	sdʒʌmp
106.	*kept*	kept	tepk	kept	tek	ket	tek
107.	*lapse*	læps	spæl	læps	slæp	læps	slæp
108.	*lapsed*	leps	slep	læpst	dəs.læp	læst	də.læs
109.	*larks*	laks	slak	laks	slak	laːks	slaːk
110.	*lend*	lent	den	lent	deŋ	lent	deŋ
111.	*lift*	lif	flip	lift	tə.li	lift	tə.lif
112.	*lisp*	lisp	pə.lis	lisp	plis	lisp	pə.lis
113.	*lived*	lif	flip	lifd	dlif	lift	dif
114.	*lives*	laifs	sfai	laifs	slaif	laifs	slaif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	klo	lok	klo	lok	ko
116.	*log*	log	go	log	ok	log	go
117.	*lump*	lʌmp	pʌm	lʌmp	pʌm	lʌmp	pʌm
118.	*matched*	mætʃt	dətʃ.mæ	mætʃt	dmætʃ	mætʃt	dmætʃ
119.	*melt*	melt	tel	melt	tel	melt	tel
120.	*milk*	miuk	kiu	miuk	kiu	miuk	kiu
121.	*misquote*	mis.kout	kout.mis	mis.kout	kout.mis	mis.kout	kout.mis
122.	*ounce*	oŋs	s.oŋ	oŋs	s.oŋ	oŋs	s.oŋ
123.	*owns*	ons	soŋ	oŋs	soŋ	oŋs	soŋ
124.	*ox*	os	so	os	so	os	so
125.	*participate*	pʌ.ti.si.pei	pei.si.ti.pʌ	pʌ.ti.si.pei	pei.si.ti.pʌ	pʌ.ti.si.pei	pei.ti.si.pʌ
126.	*peacemaking*	pis.mei.kiŋ	kin.mes.pin	pis.mei.kiŋ	mei.kiŋ.pis	pis.mei.kiŋ	mei.kiŋ.pis
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	spʌf	pʌfs	spʌf	pʌfs	spʌf
131.	*raised*	ɹeist	d.ɹeis	ɹeist	d.ɹeis	ɹeisd	d.ɹeis
132.	*range*	ɹentʃ	dʒen	ɹentʃ	dʒen	ɹentʃ	dʒɹen
133.	*recommend*	ɹi.kə.men	men.kən.ɹi	ɹi.kəm.men	men.kən.ɹe	ɹe.kəm.men	men.kən.ɹe
134.	*recruiter*	ɹi.ku.tə	tə.ku.ɹi	ɹi.ku.tə	tə.ku.ɹi	ɹi.ku.tə	tə.ku.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒə.ɹei.tə	ɹei.tə.ɹi.fɹi.dʒə	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃi.ʃən.læ.ɹi	ɹi.lei.ʃən.ʃy	ʃy.ʃən.lei.wi	ɹi.lei.ʃən.ʃy	ʃy.ʃən.lei.ɹi
137.	*representative*	ɹi.pi.sen.tə.tif	ti.tə.sem.pɹi.ɹi	ɹi.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹi	ɹi.pi.sen.tə.tif	tif.tə.sem.pɹi.ɹi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	də.ɹʌʃ	ɹʌʃt	də.ɹʌʃ	ɹʌʃt	də.ɹʌʃ
139.	*scratch*	sgætʃ	tʃæks	sgwetʃ	tʃgwes	sgwetʃ	tʃgwes
140.	*scree*	sgiː	gis	sgwiː	gwis	sgɹiː	gwis
141.	*segment*	seg.men	meŋ.sek	sek.men	men.sek	sek.men	men.sek
142.	*senseless*	sens.lis	lis.sen	sens.lis	lis.seŋs	sens.lis	lis.sens
143.	*sequence*	si.kwəns	skwən.si	si.kwəns	skwəns	si.kwəns	skwən.si
144.	*shameless*	ʃe.mu.lis	li.mi.ʃei	ʃeŋ.lis	lis.ʃen	ʃem.lis	lis.ʃem
145.	*shelve*	ʃelf	fu.ʃel	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelft	ftʃel	ʃelft	də.ʃelf	ʃelft	də.ʃelf
147.	*skate*	sgeit	teis	sgeit	geits	sgeit	geits
148.	*skating*	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei
149.	*slope*	sloup	plous	sloup	loups	sloup	loups
150.	*small*	smo	smo	smoː	moːs	smoː	moːs
151.	*smooth*	smus	s.wus	smuːθ	θmuːs	smuːθ	muːs
152.	*snatch*	snetʃ	tʃneks	snætʃ	tʃnæs	snætʃ	tʃnæs
153.	*spa*	sbaː	bas	sbaː	bas	sbaː	bas
154.	*spare*	sbe.ə	be.əs	sbeə	beəs	sbe.ə	be.əs
155.	*sphere*	sfi.ə	ə.fis	sfi.ə	fi.əs	sə.fi.ə	fi.əs
156.	*spiritual*	sbi.ɹi.tʃou	tʃou.ɹi.sbi	sbi.ɹi.tʃou	tʃou.ɹi.sbi	sbi.ɹi.tʃou	tʃou.ɹi.sbi
157.	*splendid*	sblen.di	di.ləm.bəs	sblen.di	di.blens	sblen.di	di.blens
158.	*split*	sblit	tə.blis	sblit	blis	sblit	tə.blis
159.	*spoil*	sbo.jəl	bo.jəls	sbo.jəl	bo.jəls	sboi	bois
160.	*spray*	sbɹei	bɹeis	sbɹei	bɹeis	sbɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹin	pɹins	sbɹin	bɹins	sbɹin	bɹins
162.	*springs*	sbɹins	sbɹins	sbɹiŋs	sbɹiŋs	sbɹins	sbɹiŋs
163.	*squeeze*	skwits	tskwis	sgwits	tsgwis	skwiːs	skwiːs
164.	*stain*	sdeŋ	deŋs	sdeŋ	deŋs	sdeŋ	deŋs
165.	*star*	sdaː	aːs	sdaː	das	sdaː	das
166.	*string*	sdʒiŋ	dʒiŋs	sdʒiŋ	dʒiŋs	sdʒin	dʒiŋs
167.	*stupid*	sdiu.pi	pi.sdiu	sdiu.pi	pi.sdiu	sdiu.pi	pi.sdiu
168.	*suppose*	sə.pous	sə.pou.sə	sə.pous	spou.sə	sʌ.pous	spou.sʌ
169.	*swim*	swin	wins	swin	wiŋs	swin	wins
170.	*text*	teks	tet	tekst	tekst	teks	teks
171.	*thankful*	θeŋk.fəl	fəl.θeŋk	θeŋ.fəl	fəl.θen	θeŋ.fəl	fəl.θen
172.	*trenched*	tʃentʃt	tʃi.tʃend	tʃentʃt	də.tʃentʃ	tʃentʃt	də.tʃentʃ
173.	*tweet*	tə.wit	tiut	twit	twit	twiːt	twiːt
174.	*underpaid*	ʌn.də.pei	pɹei.ʌn.də	ʌn.də.pei	pei.ʌn.də	ʌn.də.pei	pei.ʌn.də
175.	*understand*	ʌn.də.sden	sden.ʌn.də	ʌn.də.sden	sdeŋ.ʌn.də	ʌn.də.sden	sden.ʌn.də
176.	*urge*	əːtʃ	dʒ.əː	əːtʃ	dʒəː	əːtʃ	dʒ.əː
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃel	welʃ	ʃ.wel
178.	*whereabout*	weə.ə.bau	ə.bau.weə	we.ə.ə.bau	ə.bau.we.ə	we.ə.ə.bau	ə.bau.we.ə
179.	*wolf*	wouf	fou	wouf	fou	wouf	fou
180.	*woodland*	wu.læn	læn.wut	wu.læn	læn.wut	wu.læn	læn.wu

VII. GZ-M-20-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	də.fei	ə.fɹei	fɹei.də	ə.fɹei	fɹei.də
2.	*age*	eidʒ	dʒei	eitʃ	dʒei	eitʃ	dʒei
3.	*Alps*	æps	sæp	æps	sæp	æps	sel
4.	*amuse*	ə.mius	miu.sə	ə.mius	miu.sə	ə.mius	miu.sə
5.	*anguish*	en.gwiʃ	gwiʃ.en	eŋ.gwiʃ	gwiʃ.en	eŋ.gwiʃ	gwiʃ.en
6.	*anklet*	æŋk.lit	lit.æŋk	æŋk.lit	lit.æŋk	æŋk.lit	lit.æŋk
7.	*ant*	ent	ten	ent	ten	ent	ten
8.	*approve*	ə.pɹuːf	pɹu.və	ə.pɹuːf	pɹu.fə	ə.pɹuːf	pɹuf.ə
9.	*ask*	ask	kas	ask	kas	ask	kas
10.	*asked*	askt	task	askt	dask	askt	dask
11.	*asks*	ʌsks	s̩.ɐ	asks	sak	asks	sak
12.	*bangs*	bæŋs	sbæŋk	bæŋs	sbæŋk	bæŋs	sbæŋk
13.	*begged*	begd	degb	bekt	dek	begd	dekp
14.	*begs*	beks	sbek	beks	sbek	beks	sbek
15.	*blast*	blʌst	lasb	blʌst	lʌsp	blast	lasp
16.	*bled*	blet	lep	blet	lep	blet	dep
17.	*bloom*	blum	lump	bluːm	luːm	blum	lump
18.	*blunt*	blʌnt	tʌnp	blʌnt	lʌmp	blʌnt	lʌntp
19.	*blur*	bləː	ləp	bləː	ləp	bləː	ləp
20.	*brief*	bɹif	fib˺	bɹif	fip	bɹif	ɹifp
21.	*Britain*	bɹi.tən	tən.bɹi	bɹi.tən	tən.bɹi	bɹi.tən	tən.bɹi
22.	*bronze*	bɹons	sbon	bɹons	sbɹoŋ	bɹans	sɹamb

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biut	diup	biut	diup	biut	diup
24.	*bulb*	bʌub	bʌub	bʌub	bʌub	bʌup	bʌup
25.	*bulbs*	bʌups	sbʌub	bʌps	sbʌp	bʌups	sbʌup
26.	*cashback*	keʃ.bek	bek.keʃ	keʃ.bek	bek.keʃ	keʃ.bæk	bæk.kæʃ
27.	*clarify*	kle.ɹi.fʌi	fʌi.ɹi.kle	kle.ɹi.fai	fai.ɹi.kle	kle.ɹi.fai	fai.ɹi.kle
28.	*Clark*	kə.laːk	laːk	klaːk	laːk	klaːk	laːk
29.	*clear*	kliə	liək	kliə	liək	kə.liə	liək
30.	*cliff*	klif	lifk	klif	lifk	klif	flik
31.	*close*	klous	lous	klous	lousk	klous	lousk
32.	*closure*	klo.ʃə	ʃə.klo	klo.ʃə	ʃə.klo	klo.ʃə	ʃə.klo
33.	*clothing*	klou.θiŋ	θiŋ.kou	klou.θiŋ	θiŋ.klou	klou.fiŋ	fiŋ.klou
34.	*clubbed*	klʌp	dʌp	klʌpt	dʌp	klʌpt	dʌp
35.	*Constantine*	kons.ten.tin	tin.ten.kons	kons.tən.tin	tin.tən.kons	kons.tən.tin	tin.tən.kons
36.	*corpse*	kops	skop	kops	skop	kops	skop
37.	*crawl*	kɹoː	ɹoːk	kɹoː	ɹoːk	kɹoː	ɹoːk
38.	*crisp*	kɹips	skɹip	kɹis	skɹi	kɹisp	skɹiː
39.	*crow*	kɹou	ɹouk	kɹou	ɹouk	kɹou	ɹouk
40.	*crown*	kɹon	ɹonk	kɹaːn	ɹannk	kɹaŋ	ɹaŋk
41.	*cry*	kɹai	ɹaik	kɹai	ɹaik	kɹai	ɹaik
42.	*cube*	kiup	biuk	kiup	biuk	kiup	biuk
43.	*digest*	dai.dʒest	dʒes.dai	dʌi.dʒest	dʒes.dʌi	dʌi.dʒest	dʒes.dʌi
44.	*disband*	dis.bent	ben.dis	dis.bent	ben.dis	dis.bent	ben.dis
45.	*disclaim*	dis.klem	klem.dis	dis.klem	klem.dis	dis.klem	klem.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌmt	tʌmp	dʌmpt	dʌmp	dʌmpt	dʌmpt
48.	*east*	ist	tis	ist	tis	ist	tis
49.	*eats*	is	sit	is	sit	its	sit
50.	*Ed*	ed	de	ed	de	et	de
51.	*edge*	etʃ	dʒed	etʃ	dʒeː	etʃ	dʒet
52.	*elf*	elf	fel	elf	fel	elf	fel
53.	*else*	els	sel	els	sel	els	sel
54.	*elves*	efs	sef	elfs	fel	elfs	sel
55.	*encourage*	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in
56.	*encouraging*	in.kʌ.ɹi.dʒiŋ	dʒin.ɹi.kʌ.in	in.kʌ.ɹi.dʒiŋ	dʒin.ɹi.kʌ.in	in.kʌ.ɹi.dʒiŋ	dʒin.ɹi.kʌ.in
57.	*English*	iŋg.liʃ	liʃ.gə.in	iŋ.gliʃ	gliʃ.in	iŋg.liʃ	liʃ.iŋk
58.	*ex-con*	eks.kən	kən.eks	eks.kon	kon.es	eks.kon	kon.iks
59.	*excuse*	is.gjus	kjus.i	iks.gjus	gjus.is	is.gjus	gjus.iks
60.	*exhale*	eks.hel	hel.eks	iks.hel	hel.iks	iks.hel	hel.iks
61.	*explode*	iks.ploud	plou.dis	iks.blout	blou.dis	iks.blout	blou.dis
62.	*fabric*	fe.bɹik	bɹik.fe	fe.bɹik	bɹik.fe	fe.bɹik	bɹik.fe
63.	*fact*	fækt	ækt	fæt	tæf	fækt	æktf
64.	*famed*	femd	denf	femt	denf	femt	denf
65.	*fed*	fet	def	fet	def	fet	def
66.	*film*	fim	mium	fium	mif	fim	mif
67.	*fish*	fiʃ	ʃif	fiʃ	ʃif	fiʃ	ʃif
68.	*flap*	flep	lef	flep	lef	flep	lepf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flə:t	tə:ɹf	flə:t	lətf	flə:t	lətf
70.	*flu*	flu	luf	flu	luf	fluː	luf
71.	*fly*	flai	laif	flai	laif	flai	laif
72.	*foolish*	fu.liʃ	liʃ.fuː	fu.liʃ	liʃ.fuː	fu.liʃ	liʃ.fuː
73.	*frank*	fɹenk	kɹenf	fɹeŋk	kɹenf	fɹeŋk	kɹenf
74.	*Franks*	fɹeŋks	sfɹeŋk	fɹeŋks	sfɹeŋk	fɹeŋks	sfɹeŋk
75.	*free*	fɹiː	ɹiːf	fɹiː	ɹif	fɹiː	ɹif
76.	*freshness*	fɹeʃ.nis	nis.fɹeʃ	fɹeʃ.nis	nis.fɹeʃ	fɹeʃ.nis	nis.fɹeʃ
77.	*friend*	fɹend	də.fen	fɹent	wenf	fɹend	dwenf
78.	*fringe*	fɹintʃ	dʒinf	fɹintʃ	dʒinf	fɹintʃ	dʒinf
79.	*games*	gems	sgem	gems	sgem	gems	sgem
80.	*gasped*	ges.pə.də	pə.des	ges.pə.də	desp	gespt	desp
81.	*gasps*	geps	sgep	gesps	pes	gesps	sgesp
82.	*gave*	geif	feik	geif	eifk	gef	eifk
83.	*glue*	gluː	luːg	glu	lug	glu	luk
84.	*grab*	gɹep	bet	gɹep	bek	gɹep	bek
85.	*grant*	gɹent	tweng	gɹent	twenk	gɹent	twenk
86.	*grape*	gɹep	pə.gɹe	gɹeip	ɹeipk	gɹeip	ɹeipk
87.	*help*	help	pel	help	pel	help	pel
88.	*helped*	helpt	telp	helpt	pel	helpt	delp
89.	*hobnob*	hop.nop	nop.hop	hop.nop	nop.hop	hop.nop	nop.hop
90.	*implore*	im.poː	po.im	im.ploː	plo.im	im.ploː	plo.im
91.	*improve*	im.pɹuːf	pɹuf.im	im.pɹuf	pɹuf.im	im.pɹuf	pɹuf.im

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃin	intʃ	tʃwin	intʃ	tʃin
93.	*increasing*	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.den.fi.nit	ni.fi.den.in	in.de.fi.nit	ni.fi.de.in	in.de.fi.nit	ni.fi.de.in
95.	*independent*	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dən.pen.di.in
96.	*inflict*	inf.likt	likf.in	in.flikt	flik.in	in.flikt	flik.in
97.	*infuse*	in.fius	fiu.siŋ	in.fius	fiu.siŋ	in.fius	fiu.sin
98.	*ink*	ink	kin	ink	kin	ink	kin
99.	*inked*	iŋkt	tiŋk	iŋkt	tiŋk	iŋkt	diŋk
100.	*inks*	iŋks	skin	iŋks	siŋk	iŋks	siŋk
101.	*instinct*	ins.tiŋ	tiŋs.in	ins.tiŋt	tiŋs.in	ins.tiŋt	tiŋs.in
102.	*instrument*	ins.tɹə.mən	mən.tɹə.ins	in.stɹə.mən	mən.stɹə.in	ins.tɹə.mən	mən.tɹəs.in
103.	*i-Tunes*	ai.tyns	tyn.sai	ai.tyns	tyn.sai	ʌi.tyns	tyns.ʌi
104.	*jasmine*	dʒes.min	min.dʒes	dʒes.min	min.dʒes	dʒes.min	min.dʒes
105.	*jumps*	dʒʌms	sdʒʌmp	dʒʌms	sdʒʌmp	dʒʌms	sdʒʌmp
106.	*kept*	kept	tep	kept	tepk	kept	tepk
107.	*lapse*	læps	slæp	leps	slep	leps	slep
108.	*lapsed*	lepst	slep	lepst	deps	lepst	deps
109.	*larks*	laks	kə.laː	laks	slak	laks	slak
110.	*lend*	lent	dlen	lent	dlen	lent	den
111.	*lift*	lift	fə.ti	lift	tif	lift	tif
112.	*lisp*	lips	sip	lisp	plis	lisp	plis
113.	*lived*	lifd	dif	lifd	dif	lifd	dif
114.	*lives*	laifs	slaif	laifs	slaif	laifs	slaif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	kə.lo	lok	kə.lo	lok	kok
116.	*log*	loːk	gloː	lok	gloː	lok	gloː
117.	*lump*	lʌmp	pʌm	lʌmp	pʌm	lʌmp	pʌm
118.	*matched*	mætʃt	tʃi.mæt	metʃt	deptʃ	metʃt	deptʃ
119.	*melt*	melt	tel	melt	tem	melt	telm
120.	*milk*	miuk	kium	miuk	kim	miuk	kium
121.	*misquote*	mis.kwout	kwuo.mis	mis.kwout	kɹou.mis	mis.kɹou	kɹou.mis
122.	*ounce*	ɒns	s.ɒn	ons	soŋ	aŋs	s.aŋ
123.	*owns*	ons	son	ons	soŋ	ons	soŋ
124.	*ox*	ɒs	so	oks	so	ɒs	so
125.	*participate*	pʌ.ti.si.peit	pei.si.ti.pa	pʌ.ti.si.peit	pei.si.ti.pa	pʌ.ti.si.peit	pei.si.ti.pa
126.	*peacemaking*	pis.mek.kiŋ	kiŋ.mə.pis	pis.mek.kiŋ	kiŋ.mek.pis	pis.mek.kiŋ	kiŋ.mek.pis
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	spʌf	pʌfs	spʌf	pʌfs	spʌf
131.	*raised*	ɹeist	sɹei	ɹeist	dɹeis	ɹeist	dɹeis
132.	*range*	ɹentʃ	tʃɹen	ɹeintʃ	dʒein	ɹentʃ	dʒein
133.	*recommend*	ɹe.kə.mand	man.kə.ɹe	ɹe.kə.mend	men.kə.ɹe	ɹe.kə.men	men.kə.ɹe
134.	*recruiter*	ɹi.ku.tə	tə.ku.ɹi	ɹi.kɹu.tə	tə.kɹu.ɹi	ɹi.kuː.tə	tə.kuː.wi
135.	*refrigerator*	ɹi.fɹe.dʒi.ɹei.tə	tə.ɹə.dʒe.fə.ɹə	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹi.dʒə.fɹi.ɹi	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹi.dʒə.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lə.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.nei.wi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	tif.tə.sen.pɹi.ɹi	ɹe.pɹi.sen.tə.tif	tif.tə.sen.pɹi.ɹi	ɹe.pɹi.sen.tə.tif	tif.tə.sen.pɹi.ɹi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	dʌʃ	ɹʌʃt	dwʌʃ	ɹʌʃt	dwʌʃ
139.	*scratch*	skɹetʃ	kɹe.tʃis	skɹetʃ	kɹetʃs	skɹetʃ	kɹe.tʃis
140.	*scree*	skɹiː	kɹiːs	skɹiː	kɹis	skɹiː	kɹis
141.	*segment*	sig.mən	mən.sik	seg.mən	mən.sek	seg.mənt	mən.sek
142.	*senseless*	sen.sz̩.les	li.sə.sen	sens.nis	nis.sens	sen.sn̩.nis	ni.sə.sen
143.	*sequence*	si.kwən	kwən.sis	si.kwəns	kwən.si	si.kwəns	kwən.si
144.	*shameless*	ʃeim.nis	ni.ʃeim	ʃeim.nis	lis.ʃeim	ʃem.nis	lis.ʃem
145.	*shelve*	ʃelf	fv̩.ʃel	ʃelf	felʃ	ʃelf	elʃ
146.	*shelved*	ʃelft	delf	ʃelft	delʃ	ʃelft	delfʃ
147.	*skate*	sget	gets	sgeit	geits	sgeit	geits
148.	*skating*	sge.tiŋ	tiŋ.sgei	sge.tiŋ	tiŋ.sgei	sgei.tiŋ	tiŋ.sgei
149.	*slope*	sloup	loups	sloup	loups	slop	lops
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuːf	muːps	smuf	mups	smuf	mups
152.	*snatch*	snetʃ	ne.tʃis	snetʃ	ne.tʃis	snetʃ	netʃs
153.	*spa*	sbaː	bas	sbaː	bas	sbaː	bas
154.	*spare*	sbeə	beəs	sbeə	beəs	sbeəɹ	beəs
155.	*sphere*	sfiə	fiəs	sfiə	fiəs	sfiə	fiəs
156.	*spiritual*	sbi.ɹi.tʃou	tʃou.ɹi.bis	sbi.ɹi.tʃou	tʃou.ɹi.sbi	sbi.ɹi.tʃou	tʃou.ɹi.sbi
157.	*splendid*	sz.blen.dit	di.len.pəs	səp.blen.dit	di.len.sip	səp.blen.did	di.blen.sit
158.	*split*	sz̩.blit	lis	split	lips	split	blis
159.	*spoil*	sbo.jəu	bo.jəus	sbo.jəu	bo.jəus	sbo.jəu	bo.jəus
160.	*spray*	spɹei	pɹeis	spɹei	pɹeis	spɹei	pɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹiŋ	pɹins	sbɹiŋ	pɹiŋs	sbɹiŋ	bɹiŋs
162.	*springs*	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹins	sbɹins
163.	*squeeze*	skwiːs	kwi.sis	skwiːs	kwi.sis	skwiːs	kwi.sis
164.	*stain*	sten	tens	stein	teins	stein	tens
165.	*star*	sdaː	taːs	sdaː	taːs	sdaː	taːs
166.	*string*	sdɹiːŋ	ɹiːŋs	sdɹiŋ	dɹiŋs	sdɹiŋ	dɹiŋs
167.	*stupid*	sdju.pit	pi.sdju	sdju.pit	pi.sdju	sdju.pit	pi.sdju
168.	*suppose*	sə.pous	pou.səp	sə.pous	pou.səp	sə.pous	pou.səp
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tekst	tekst	tekst	tekst	tekst	test
171.	*thankful*	fen.fəu	fəu.fenk	feŋk.fəu	fəu.feŋk	feŋk.fəu	fəu.feŋk
172.	*trenched*	tʃentʃt	tʃen	tʃentʃt	dʒentʃ	tʃentʃt	dwentʃ
173.	*tweet*	twiːt	wiːt	twit	twit	twiːt	twiːt
174.	*underpaid*	ʌn.də.pei	pei.də.ʌn	ʌn.də.pei	pei.də.ʌn	ʌn.də.pei	pei.də.ʌn
175.	*understand*	ʌn.də.sdan	sdan.də.ʌn	ʌn.də.sden	sden.də.ʌn	ʌn.də.sden	sden.ʌn.də
176.	*urge*	əːɹtʃ	dʒi.əːɹ	əɹtʃ	dʒə	ətʃ	dʒəː
177.	*Welsh*	welʃ	ʃel	welʃ	ʃel	welʃ	ʃel
178.	*whereabout*	we.ə.bau	bau.ə.we	we.ə.baut	bau.ə.weə	we.ə.bout	bou.də.we
179.	*wolf*	wuːf	fuː	wuːf	fuː	wuf	fu
180.	*woodland*	wut.lent	len.wut	wut.lent	len.wut	wut.lent	lend.wut

VIII. GZ-F-22-01 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeit	fɹei.ə	ə.fɹeit	fɹeit.ə	ə.fɹeit	fɹet.ə
2.	*age*	eitʃ	dʒ.ei	eitʃ	dʒi.ei	eitʃ	dʒ.ei
3.	*Alps*	ælps	s.ælp	ælps	s.ælp	elps	s.elp
4.	*amuse*	ə.mius	mius.ə	ə.mius	mius.ə	ə.mius	mius.ə
5.	*anguish*	æŋ.gwiʃ	gwiʃ.æn	æn.gwiʃ	gwiʃ.æn	æŋ.gwiʃ	ʃi.gu.æn
6.	*anklet*	æŋk.lit	lit.æŋk	æŋk.lit	lit.æŋk	en.klet	klet.en
7.	*ant*	ant	t.an	aŋt	tə.aŋ	aŋt	tə.aŋ
8.	*approve*	əpɹuf	f̩.pɹu.ə	ə.puf	puf.ə	ə.pɹuf	puf.ə
9.	*ask*	ask	kəs.ɐ	ask	ska	ask	kəs.a
10.	*asked*	aːs.kə.də	kə.də.aːs	askt	skdə.ap	askt	kə.də.as
11.	*asks*	aks	s̩.ak	asks	kəs.as	asks	sk.as
12.	*bangs*	bens	sben	baŋgs	sbaŋg	baŋs	sbaŋk
13.	*begged*	begd	gdbe	begd	gdbeg	begd	gdbek
14.	*begs*	beks	sbek	begs	sbek	beks	sbek
15.	*blast*	blaːs	laːs.bə	blast	lastb	blast	lastb
16.	*bled*	blet	lebd	blet	letp	blet	letp
17.	*bloom*	blom	lomb	bə.lom	lom.bə	bə.lom	bom.bə
18.	*blunt*	blont	lontp	bləmt	ləntb	bləmt	tə.bləm
19.	*blur*	bləː	ləːb	bləːɹ	ləːb	bləːɹ	ləːp
20.	*brief*	bɹif	fɹip	bɹiːf	ɹiːfb	bɹiːf	ɹifp
21.	*Britain*	bɹi.tən	tən.bɹi	bɹi.tən	tən.bɹi	bɹi.tən	təp.bɹi
22.	*bronze*	bɹɒonns	zbɹɒːn	bɹons	zbɹom	bɹans	tsbɹan

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	ɪudb	biut	də.biu	biut	də.biu
24.	*bulb*	bʌub	bə.bʌu	bʌub	bə.bau	bʌup	bə.bʌu
25.	*bulbs*	baubs	sbaub	bʌups	sbʌup	bʌups	sbʌup
26.	*cashback*	kæʃ.bek	kə.beʃ.kæ	keʃ.bek	bek.keʃ	keʃ.bek	bek.keʃ
27.	*clarify*	kə.le.ɹi.fʌi	fʌi.ɹi.le.kə	kə.le.ɹi.fai	fai.ɹi.le.kə	kə.læ.ɹi.fai	fai.ɹi.læ.kə
28.	*Clark*	kə.laːk	aː.kə.lə	kə.laːk	akl	kə.lak	lakk
29.	*clear*	kə.le.əɹ	e.əɹ.kə.lə	kə.leəɹ	eəɹ.kə.lə	kə.leəɹ	eəɹkl
30.	*cliff*	kə.lif	fkə.li	kə.lif	lifk	kə.lif	fkli
31.	*close*	kə.lous	lousk	kə.lous	lousk	kə.lous	lousk
32.	*closure*	kə.lou.dʒə	dʒə.lou.kə	kə.lou.ʒə	ʒə.kə.lou	kə.lou.ʒə	dʒə.kə.lou
33.	*clothing*	kə.lou.fiŋ	θiŋ.lou.kə	kə.lou.fiŋ	θiŋ.kə.lou	kə.lou.fiŋ	θiŋ.kə.lou
34.	*clubbed*	kə.lʌbd	bd.klʌ	kə.lʌbd	bdklʌ	kə.lʌpt	bdklʌ
35.	*Constantine*	kons.tən.tin	tin.tən.kons	kos.tən.tin	tin.stən.kon	kons.tən.tin	tin.tən.skon
36.	*corpse*	koːɹps	skoːɹp	kops	skop	kops	skop
37.	*crawl*	kɹʌu	auk	kɹoː	okɹ	kɹau.ou	ou.kɹau
38.	*crisp*	kɹisp	spkɹik	kɹisp	spə.kɹip	kɹisp	spə.kɹis
39.	*crow*	kɹou	oukɹ	kɹau	aukɹ	kɹou	oukɹ
40.	*crown*	kɹoːn	oːnk	kɹoːm	oːŋkɹ	kɹoːm	omkɹ
41.	*cry*	kwai	ɹaik	kɹai	aikɹ	kɹʌi	ʌikɹ
42.	*cube*	kjuːp	bkjuː	kjuːp	bə.kjuː	kjup	bə.kjuː
43.	*digest*	dʌi.dʒes	dʒes.dʌi	dʌi.dʒes	dʒes.dʌi	dʌi.dʒes	dʒes.dʌi
44.	*disband*	dis.bænd	bens.di	dis.bent	bens.di	dis.bent	bent.dis
45.	*disclaim*	dis.klaːm	lan.kə.dis	dis.kə.leim	kə.leim.dis	dis.kə.leim	neim.kə.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌmpt	ptdʌm	dəmpt	pə.də.dəm	dʌmpt	pə.də.dʌm
48.	*east*	ist	stə.i	ist	stə.i	ist	tə.is
49.	*eats*	is	sz̩.i	is	s.i	is	s.it
50.	*Ed*	ed	də.e	et	də.e	et	də.eʔ
51.	*edge*	etʃ	dʒ.e	etʃ	dʒ.e	etʃ	dʒ.e
52.	*elf*	elf	fv̩.el	elf	f̩.el	elf	f̩.el
53.	*else*	els	s̩.el	els	s.el	els	s.el
54.	*elves*	elvz	vz.el	elfs	fs.el	elfs	s.elf
55.	*encourage*	in.ko.ɹidʒ	dʒi.ɹi.ko.in	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in	in.ko.ɹitʃ	ɹitʃ.ko.in
56.	*encouraging*	iŋ.ko.ɹi.dʒin	dʒin.ɹi.ko.iŋ	iŋ.ko.ɹi.dʒiŋ	diŋ.ɹi.ko.in	iŋ.ko.ɹi.dʒiŋ	diŋ.ɹi.ko.in
57.	*English*	iŋg.liʃ	ʃi.li.gə.in	iŋ.gliʃ	liʃg.in	iŋg.liʃ	liʃg.in
58.	*ex-con*	is.koːn	kon.is	is.kon	kon.is	is.kom	kom.is
59.	*excuse*	is.kius	kius.is	is.kius	kius.is	is.kius	kius.is
60.	*exhale*	is.hel	hel.is	is.hel	hel.is	es.hel	hel.is
61.	*explode*	es.ploud	ploud.es	is.plout	ploud.is	is.ploud	ploud.is
62.	*fabric*	fɹe.bik	ɹik.bi.fe	fep.bɹik	bɹik.fe	fep.bɹik	bɹik.fe
63.	*fact*	fet	tə.fe	fet	tfe	fet	tə.fe
64.	*famed*	feimd	də.feim	feimt	də.feim	feimd	də.feim
65.	*fed*	fet	etf	fet	də.fe	fet	də.fe
66.	*film*	fiu	iuf	fium	iunf	fium	inf
67.	*fish*	fiʃ	ʃi.fi	fiʃ	ʃi.fi	fiʃ	ʃfi
68.	*flap*	flæp	læpf	flep	lepf	flep	lepf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	flət	lətf	flə:t	lətf	flə:ɹt	ləɹtf
70.	*flu*	flu:	lu:f	flu:	luf	flu:	luf
71.	*fly*	flai	laif	flʌi	lʌif	flʌi	lʌif
72.	*foolish*	fu:.liʃ	liʃ.fu:	fu:.liʃ	liʃ.fu:	fu:.liʃ	liʃ.fu:
73.	*frank*	fɹæŋk	kə.fɹen	fɹeŋk	kə.fɹen	fɹeŋk	kə.fɹen
74.	*Franks*	fæŋks	sfɹæŋk	fɹenks	skfɹen	fɹeŋks	skfɹen
75.	*free*	fɹi:	i:f	fɹi:	ɹif	fɹi:	i:f
76.	*freshness*	fɹeʃ.nis	nis.ʃi.fɹe	fɹeʃ.nis	nis.fɹeʃ	fɹeʃ.nis	nis.fɹeʃ
77.	*friend*	fɹent	en.də.fɹi	fɹent	end.fɹi	fɹent	də.fɹen
78.	*fringe*	fɹintʃ	dʒi.fɹiŋ	fɹiŋtʃ	dʒ.fɹiŋ	fɹintʃ	dʒ.fɹiŋ
79.	*games*	gems	sgem	gems	sgeim	gems	sgem
80.	*gasped*	ges.pə.də	pə.də.ges	gasp	pəs.ga	geispt	pə.də.geis
81.	*gasps*	geps	sge	gesps	pəs.ges	gesps	spges
82.	*gave*	gef	fge	gef	fgei	geif	fgei
83.	*glue*	gə.lu:	lu:g	gə.lu:	lu:g	glu:	lu:k
84.	*grab*	gɹep	bə.gɹe	gɹep	bə.gɹe	gɹep	bə.gɹe
85.	*grant*	gɹænt	antgɹ	gɹent	tə.gɹen	gɹent	tə.gɹen
86.	*grape*	gɹeip	pə.ɹeik	gɹeip	pə.gɹei	gɹeip	pə.gɹei
87.	*help*	help	pə.hel	help	pə.hel	help	pə.hel
88.	*helped*	help.də	pət.hel	helpt	pə.də.hel	helpt	pə.də.hel
89.	*hobnob*	hob.nob	nob.ho	hop.nop	nop.hop	hop.nop	nop.hop
90.	*implore*	im.plo:	lop.im	im.plo:	plo:.im	im.plo:	plo.in
91.	*improve*	im.pɹuf	pɹuf.im	im.pɹuf	pɹuf.in	im.pɹuf	pɹuf.in

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃi.in	intʃ	tʃ.in	intʃ	tʃi.in
93.	*increasing*	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.iŋ	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fi.nit	ni.fi.de.in	in.de.fi.nit	nit.fi.de.in	in.di.fi.nit	ni.fi.di.in
95.	*independent*	in.di.pen.dənt	dən.pen.di.in	in.di.pen.dənt	dəm.pen.di.it	in.di.pen.dən	dən.pen.dit.in
96.	*inflict*	in.flit	lit.fv.in	in.flit	flit.in	in.flit	lit.fi.in
97.	*infuse*	in.fius	fius.im	in.fius	fius.in	in.fius	fius.in
98.	*ink*	ink	kiŋ	ink	kə.in	iŋk	kə.in
99.	*inked*	iŋkt	kə.də.in	iŋkt	kə.də.iŋ	iŋkt	kə.də.in
100.	*inks*	iŋks	skə.in	iŋks	kəs.in	iŋks	skə.in
101.	*instinct*	in.stint	tins.in	in.stint	tins.in	ins.tint	tins.in
102.	*instrument*	in.stʃʌ.mən	mən.stʃʌ.in	in.stʃʌ.mən	mən.stʃʌ.in	in.stʃʌ.mənt	mən.stʃʌ.in
103.	*i-Tunes*	ʌi.tyns	tyns.ʌi	ai.tjuns	tjuns.ai	ʌi.tjuns	tjuns.ʌi
104.	*jasmine*	dʒes.min	mins.dʒe	dʒes.min	mins.dʒe	dʒeis.min	min.dʒeis
105.	*jumps*	dʒʌms	sdʒʌm̩	dʒʌms	sdʒʌmp	dʒʌmps	sdʒʌmp
106.	*kept*	kept	tə.kep	kept	tə.kep	kept	pə.tə.kep
107.	*lapse*	læps	slæp	les	slep	læps	slæp
108.	*lapsed*	lepst	stlep	lest	sdlep	lepst	sdlep
109.	*larks*	laks	slak	las	slak	laks	slak
110.	*lend*	lend	dlen	lend	dlen	lent	də.len
111.	*lift*	lift	fy̩.tə.li	lift	ftli	lift	təf.li
112.	*lisp*	lisp	slip	lisp	spə.li	lisp	pə.lis
113.	*lived*	lift	fy̩.də.li	lift	fdli	lift	fdli
114.	*lives*	lʌifs	sflʌi	lʌifs	fslai	lʌifs	slʌif

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	kə.lo	lok	kə.lok	lok	kə.lo
116.	*log*	lok	gə.lo	lok	gə.lo	log	glo
117.	*lump*	lʌmp	pə.lʌm	nʌmp	pə.nʌm	nʌmp	pə.lʌm
118.	*matched*	metʃt	tʃdme	metʃt	tʃi.də.me	metʃt	tʃdme
119.	*melt*	melt	tə.mel	melt	tə.mel	melt	tə.mel
120.	*milk*	miuk	kə.miu	miuk	kə.miu	miuk	kə.miu
121.	*misquote*	mis.kwout	tə.kwo.mis	mis.kwout	kwout.mis	mis.kwout	kwout.mis
122.	*ounce*	auns	s.aun	ɒ:ns	s.ɒ:m	oms	s.om
123.	*owns*	ons	s̩.on	oms	s.om	oms	s.on
124.	*ox*	os	s̩.o	os	s.o	os	s.o
125.	*participate*	paɹ.ti.si.pei	pei.si.ti.paɹ	pʌ.ti.si.peit	pei.si.ti.pʌ	paɹ.ti.si.pei	pei.si.ti.pʌ
126.	*peacemaking*	pi:s.me.kiŋ	kiŋ.mes.pi:	pi:s.mei.kiŋ	kiŋ.meis.pi:	pi:s.mei.kiŋ	mei.kiŋ.pi:s
127.	*play*	plei	leip	plei	leip	plei	leip
128.	*pray*	pɹei	ɹeip	pɹei	eipɹ	pɹei	eip
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pʌfs	sfpʌu	pus	spuf	pufs	spuf
131.	*raised*	ɹeist	stə.ɹei	ɹeisd	sdɹei	ɹeist	sdɹei
132.	*range*	ɹentʃ	dʒi.ɹen	ɹæntʃ	dʒi.ɹæn	ɹentʃ	dʒi.ɹen
133.	*recommend*	ɹi.kə.me:nt	men.kən.ɹi	ɹe.kə.mend	men.kən.ɹe	ɹe.kə.ment	men.kən.ɹe
134.	*recruiter*	ɹi.kɹu:.tə	tə.kɹu:.ɹi	ɹi.kɹi.tə	tə.kɹi.ɹi	ɹi.kɹi.tə	tə.kɹi.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒi.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒə.fɹi.ɹi	ɹi.fɹi.dʒə.ɹei.tə	tə.ɹei.dʒi.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.nei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	tif.tə.sen.pɹi.ɹi	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹi	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹi

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌʃt	ʃdɹʌ	ɹʌʃt	ʃdɹʌʔ	ɹʌʃt	ʃdɹʌ
139.	*scratch*	skɹetʃ	tʃkɹes	skɹetʃ	kɹetʃs	skɹetʃ	tʃi.gɹes
140.	*scree*	skɹiː	ɹiː.kəs	skɹiː	kɹiːs	skɹiː	kɹiːs
141.	*segment*	seg.mənt	məng.seg	seg.mənt	mənt.sek	seg.mənt	mənt.sek
142.	*senseless*	se.sz̩.lis	lis.si.sen	sen.si.nis	nis.si.sen	sen.si.nis	nis.si.sen
143.	*sequence*	siː.kwəns	kwəns.si	si.kwəns	kwəns.siː	si.kwəns	kwəns.sit
144.	*shameless*	ʃeim.nis	lis.ʃeim	ʃeim.nis	nis.ʃeim	ʃeim.nis	nis.ʃem
145.	*shelve*	ʃelf	fʃel	ʃelf	fʃel	ʃelf	fʃel
146.	*shelved*	ʃelfd	fdʃel	ʃelft	fdʃel	ʃelfd	fdʃel
147.	*skate*	skeit	tə.skei	skeit	geits	skeit	tə.geis
148.	*skating*	skei.tiŋ	tiŋ.skei	skei.tiŋ	tiŋ.geis	skei.tiŋ	tiŋ.geis
149.	*slope*	sloup	pə.lous	sloup	pə.lous	sloup	pə.lous
150.	*small*	smoː	moːs	smoː	moːs	smoː	moːs
151.	*smooth*	smuθ	muθs	smuf	mufs	smuf	mufs
152.	*snatch*	snetʃ	tʃi.nes	snetʃ	tʃnes	snetʃ	tʃnes
153.	*spa*	spaː	pas	spaː	baːs	spaː	baːs
154.	*spare*	spe.əɹ	be.əɹs	spe.əɹ	be.əɹs	spe.əɹ	be.əɹs
155.	*sphere*	sz̩.fi.ə	fi.əs	sfi.əɹ	fi.əs	sfi.əɹ	fi.əɹs
156.	*spiritual*	spi.ɹi.tʃəu	tʃou.ɹi.spi	spit.ɹi.tʃou	tʃou.ɹi.spit	spit.ɹi.tʃou	tʃou.ɹi.spit
157.	*splendid*	splen.dit	di.blens	splen.dit	dit.blens	splen.dit	dip.blens
158.	*split*	split	blis	sblit	lisb	sblit	blis
159.	*spoil*	spo.jəu	o.jəu.pəs	spo.jəu	bo.jəus	spo.jəu	əu.bois
160.	*spray*	spɹei	ɹeisp	spɹei	bɹeis	spɹei	bɹeis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹim	ɹimps	spɹiŋ	pɹiŋs	spɹiŋ	bɹiŋs
162.	*springs*	spɹiŋs	ɹiŋs.spə	spɹiŋs	bɹiŋss	spɹiŋs	spɹiŋs
163.	*squeeze*	skwiːts	tskwiːs	skwiːts	kwitss	skwiːs	kwiss
164.	*stain*	stem	tems	stem	dems	stem	dems
165.	*star*	staː	daːs	staː	daːs	staː	daːs
166.	*string*	stɹiŋ	ɹiŋstʃ	stɹiŋ	dɹims	stɹim	dɹims
167.	*stupid*	stjuː.pit	pi.stjuː	stjuː.bit	bis.djuː	stjuː.bit	bis.djuː
168.	*suppose*	sə.pous	pou.səp	səp.pous	pou.səp	səp.pous	pous.səp
169.	*swim*	swiːm	wiːms	swiːm	wiːms	swiːm	wiːms
170.	*text*	test	tə.tes	test	st.te	test	st.teʔ
171.	*thankful*	θeŋk.fəu	fəu.θeŋk	θeŋk.fəu	fəu.feŋk	θeŋk.fəu	fəu.feŋk
172.	*trenched*	tʃentʃd	tʃdtʃen	tʃentʃt	tʃdtʃen	tʃentʃt	tʃid.tʃen
173.	*tweet*	twit	tə.twi	twit	itʃ	twit	itt^{w}
174.	*underpaid*	ʌn.dəɹ.peit	pei.dəɹ.ən	ʌn.də.peit	pei.dəɹ.ʌn	ʌn.də.peit	pei.də.ən
175.	*understand*	ʌn.dəɹ.stend	den.stəɹ.ən	ʌn.dəɹ.sten	dens.dəɹ.ən	ʌn.dəɹ.stent	dens.dəɹ.ən
176.	*urge*	əːɹtʃ	tʃi.əːɹ	əːɹtʃ	dʒi.əːɹ	əːɹtʃ	dʒi.əːɹ
177.	*Welsh*	welʃ	ʃi.wel	welʃ	ʃ.wel	welʃ	ʃwel
178.	*whereabout*	weə.ə.bout	bou.ə.weə	weə.ə.baut	baut.ə.weə	weə.ə.baut	baut.ə.weə
179.	*wolf*	wof	fv.wo	woːf	fwoː	woːf	fwoː
180.	*woodland*	wu.lend	lend.wud	wut.lent	lend.wut	wut.lent	len.wut

IX. GZ-F-22-02 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ʌf.ɹeid	fɹeï.	ʌ.fɹeid	fɹeid.əː	ʌ.fɹʌid	fɹʌid.əː
2.	*age*	eidʒ	dʒei	eidʒ	dʒ.ei	eidʒ	dʒ.ei
3.	*Alps*	æups	s.æup	æups	s.æup	eups	s.eup
4.	*amuse*	ʌ.mius	mjuː.səː	ʌ.mius	mjuː.səː	ʌ.mius	mjuːs.əː
5.	*anguish*	æŋ.gwiʃ	ʃ.gwi.æn	æŋ.gwiʃ	gwiʃ.æn	æŋ.gwiʃ	gwiʃ.æn
6.	*anklet*	æŋk.læt	læk.æŋk	æŋk.læt	læk.æŋk	æŋk.leːt	kleit.æn
7.	*ant*	ænt	tæn	ænt	t.æːn	ænt	t.æːn
8.	*approve*	ʌ.pɹuːf	pɹuː.faː	ʌ.pɹuːf	pɹuːf.əː	ʌ.pɹuːf	pɹuːf.əː
9.	*ask*	aːsk	kə.saː	aːsk	ks.aː	aːsk	ks.aː
10.	*asked*	aːs.kt	kt.aːs	aːs.kt	kt.aːs	aːs.kt	kt.aːs
11.	*asks*	aːs.ts	sks.aː	aːs.ks	ks.aːs	aːsks	s.aːsk
12.	*bangs*	bæŋs.s	s.bæŋ	bæŋs.s	s.pæːŋ	bænts.s	s.pæːŋ
13.	*begged*	bægd	gəd.bæːg	bækt	kt.bæ	bækt	kt.bæ
14.	*begs*	bæks	spæg	bæks	spæg	bæks	spæg
15.	*blast*	blaːst	tis.blaː	blæːst	st.blæː	blaːst	st.blaː
16.	*bled*	blæːd	du.bleə	blæːt^h	du.blæː	blæːd	du.blæ
17.	*bloom*	bluːm	luːmb	bluːm	luːmb	bluːm	luːmb
18.	*blunt*	blamt	tə.blam	blaːnt	tə.blaːn	blʌnt	t.blʌŋ
19.	*blur*	bləː	ləːb	bləː	ləːb	bləː	ləːb
20.	*brief*	bɹiːf	fiːb	bɹiːf	ɹiːfp	bɹiːf	f.pɹiː
21.	*Britain*	bɹiː.tʌn	tʌm.bɹiː	bɹiː.tʌn	tʌm.bɹiː	bɹiː.tʌn	tʌm.bɹiː
22.	*bronze*	bɹonds	zi.bɹoŋ	bɹoːŋz	zi.bɹoŋ	bɹoŋz	z.bɹoːŋ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	bjuːt^{h}	dʌ.bjuː	bjuːd	də.bjuː	biud	d.biu
24.	*bulb*	baup	baup	baup	bə.bau	baup	bə.bau
25.	*bulbs*	baubs	spaub	baubs	spaub	baups	spaup
26.	*cashback*	kæʃ.bæk	b̆.kæʃ	kæʃ.bæk	bæ.kaʃ	kæʃ.pæk	bæ.kaʃ
27.	*clarify*	klæː.ɹiː.faːj	fai.ɹi.kley	klæː.ɹiː.faːj	fai.ɹiː.kleː	klæː.ɹiː.faːj	fai.ɹiː.kleː
28.	*Clark*	klaːk	kɹaːk	klaːk	kə.laː	klaːk	k.klaː
29.	*clear*	kliə	liː.ʌk	kliː.əɹ	liː.ʌk	kleː.ə	liː.ʌɹk
30.	*cliff*	kliːf	f.kliː	kliːf	f.kliː	kliːf	f.kliː
31.	*close*	klous	sklou	klous	sklou	klʌus	s.klʌu
32.	*closure*	klou.ʒə	ʒuəɹ.klou	klou.ʒə	ʒəː.klʌu	klou.ʒəː	ʒəː.klʌu
33.	*clothing*	klou.θiŋ	iŋ.klʌu	klɒː.siŋ	siŋ.klɒː	klʌu.siŋ	siŋ.klou
34.	*clubbed*	klaːpt	bt.klaːp	klaː.pt	bt.klaːp	klaːpt	pt.klaːʔ
35.	*Constantine*	kɒːn.stʌn.tiːn	tiːn.təns.kɒːn	kɒːn.stʌn.tiːn	tiːn.stəŋ.kɒːn	kɒːn.stʌn.tiːn	tiːn.təns.kɒːn
36.	*corpse*	koːfs	sf.koː	kɒːfs	skɒːp	kɒps	skɒp
37.	*crawl*	kɹɒ	ɒːk	kɹaːw	ɹaːwk	kɹɒː	ɹoːk
38.	*crisp*	kɹiːsp	pəs.kɹiː	kɹiːsp	pʌs.kɹiː	kɹiːsp	pʌs.kɹiː
39.	*crow*	kɹou	ɹʌuk	kɹʌu	ɹʌuk	kɹʌu	ɹʌuk
40.	*crown*	kɹaːn	naː ŋ k	kɹaːn	ɹaːŋk	kɹaːŋ	ɹaːŋk
41.	*cry*	kɹai	ɹaik	kɹaːj	ɹaːjk	kɹaːj	ɹaːjk
42.	*cube*	kjuːp	bʌ.kjuː	kjuːb	bə.kjuː	kjuːp	bə.kjuː
43.	*digest*	dai.dʒest	dʒes.dai	dai.dʒæːst	dʒes.dai	dai.dʒæːst	dʒes.dai
44.	*disband*	dis.bænt^{h}	bæn.diːs	dis.bænt^{h}	bæn.diːs	dis.bænt^{h}	bæn.diːs
45.	*disclaim*	dis.kleim	kleːm.dis	dis.kleim	kleim.diːs	dis.kleim	kleːm.diːs

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gas	kas.diːs	dis.gas	kas.diːs	dis.kaːs	kaːs.diːs
47.	*dumped*	daːmpt	pə.daːm	daːmpt	pt.daːm	daːmpt	pt.daːm
48.	*east*	iːst	tə.iːs	iːst	st.iː	iːst	ts.iː
49.	*eats*	iːts	ts.iː	iːts	ts.iː	iːts	ts.iː
50.	*Ed*	æː.t^h	də.eː	æːt	d.æː	æːt	d.æː
51.	*edge*	æːtʃ	dʒu.æː	æːtʃ	dʒu.æː	æːtʃ	dʒu.æː
52.	*elf*	æuf	fæu	æuf	f.eu	euf	f.eu
53.	*else*	æus	sæu	æus	s.æu	eus	s.eu
54.	*elves*	eu.fs	vs.æu	eu.fs	s.euf	eu.fs	s.euf
55.	*encourage*	iŋ.kɒː.ɹiːtʃ	ɹiːtʃ.kɒː.iːn	iŋ.kɒː.ɹiːtʃ	ɹiːtʃ.kaː.iːn	iŋ.kɒː.ɹiːtʃ	ɹiːtʃ.kaː.iːn
56.	*encouraging*	iŋ.kɒː.ɹe.dʒuiŋ	dʒuiŋ.ɹə.kɒː.iːn	iŋ.kɒː.ɹi.$dʒ^w$iːŋ	dʒuiŋ.ɹiː.kɒː.iːn	iŋ.kɒː.ɹi.$dʒ^w$iŋ	dʒiːn.ɹiː.kaː.iːn
57.	*English*	iŋ.gleʃ	gleʃ.iːn	iŋ.gleʃ	liʃ.iŋk	iŋ.gleiʃ	leːʃ.iːŋk
58.	*ex-con*	eks.kɒn	kɒn.eːks	eks.kɒn	kɒn.eks	eks.kɒn	kɒn.ekts
59.	*excuse*	is.kjuːs	kuːs.iːs	eks.kjuːs	kjuːs.iːks	eks.kjuːs	kjuːs.eːks
60.	*exhale*	iks.hæu	hæu.eks	eks.hæu	hæu.eːks	eks.hæu	hæu.eːks
61.	*explode*	eks.blʌud	blʌu.eːks	eks.blʌud	blʌud.eːks	eks.plʌud	blʌud.eːks
62.	*fabric*	fæ.bɹeik	bɹif.f	fæː.bɹiːk	bɹik.fæː	fæː.bɹeik	bɹik.fæː
63.	*fact*	fækt	tə.fæ	fækt	t.fæ	fækt	kt.fæ
64.	*famed*	feimd	də.feim	feimd	də.fein	feimd	d.feim
65.	*fed*	fæːd	dæːf	fæːd	du.fæː	fæːd	də.fæː
66.	*film*	fium	mi.leif	fium	eumpf	fium	iumpf
67.	*fish*	fiːʃ	ʃfiː	feiʃ	ʃfiː	fiːʃ	ʃfiː
68.	*flap*	flæp	pə.flæ	flæp	pə.flæ	flæːp	læːpf

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	fləːt	laː.tf	fləːt	ləː.tf	fləːt	t.fləː
70.	*flu*	fluː	uːf	fluː	luːf	fluː	luːf
71.	*fly*	flai	laif	flaːj	laːjf	flaːj	laːjf
72.	*foolish*	fuː.leiʃ	liʃ.fuː	fuː.leʃ	leːʃ.fuː	fuː.leiʃ	leːʃ.fuː
73.	*frank*	fɹæŋk	kʌ.fɹæn	fɹænk	k.fɹæn	fɹæŋk	k.fɹæn
74.	*Franks*	fɹæŋg.s	s.fɹæŋk	fɹæŋg.s	s.fɹæŋk	fɹæŋks	s.fɹæŋk
75.	*free*	fɹiː	ɹiːf	fɹiː	ɹiːf	fɹiː	ɹiːf
76.	*freshness*	fɹæʃ.neːs	niːs.fɹæʃ	fɹæʃ.neːs	nis.fɹæʃ	fɹæʃ.neis	nis.fɹæʃ
77.	*friend*	fɹænd	dɣf.ɹn	fɹænd	də.fɹæn	fɹænd	də.fɹæn
78.	*fringe*	fɹindʒ	dʒu.fɹin	fɹindʒ	dʒu.fɹin	fɹindʒ	dʒ.fɹin
79.	*games*	gæŋs	s.gʌim	geims	s.gʌim	geim.s	s.gein
80.	*gasped*	gas.pt	pʌt.gæs	gæs.pt	pʌt.gæs	gæs.pt	pʌt.gæs
81.	*gasps*	gaːps	skaːs	gæs.ps	ps.gæs	gæs.ps	sp.gæs
82.	*gave*	geif	f.gʌi	geif	f.gʌi	geif	f.gʌi
83.	*glue*	gluː	luːg	gluː	luːg	gluː	luːg
84.	*grab*	gɹæb	bə.gɹæ	gɹæp^h	bə.gɹæ	gɹæp^h	b.gɹæː
85.	*grant*	gɹænt	tu.gɹæn	gɹænt	t.gɹæn	gɹænt	t.gɹæn
86.	*grape*	gɹeip	pʌ.gɹei	gɹeip	pʌ.gɹei	gɹeip	pʌ.gɹei
87.	*help*	hæup	pə.hæu	heup	p.heu	heup	p.heu
88.	*helped*	heupt	pəːt.heu	heupt	pʌt.hæu	heupt	pʌt.heu
89.	*hobnob*	hɒb.nɒːb	nɒb.hɒːb	hɒp.nɒːp	nɒp.hɒːp	hɒp.nɒːb	nɒp.hɒːp
90.	*implore*	im.ploː	ploː.iːm	im.ploː	ploː.iːm	im.ploː	ploː.iːm
91.	*improve*	im.pɹ.uːf	pɹoːf.iːm	im.pɹ.uːf	pɹoːf.iːm	im.pɹuːf	pɹuːf.iːm

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	*Tested words*	Normal-1	Reverse-1	Normal-2	Reverse-2	Normal-3	Reverse-3
92.	*inch*	intʃ	tʃin	intʃ	tʃ.in	i:ntʃ	tʃ.i:n
93.	*increasing*	i:ŋ.kɹi:.si:ŋ	siŋ.kɹi:.i:n	i:ŋ.kɹi:.si:ŋ	siŋ.kɹʷi:.i:n	iŋ.kɹi:.si:ŋ	siŋ.kɹʷi:.i:n
94.	*indefinite*	i:n.dæ:.fi.nʌit	nʌi.fi:.dæ:.i:n	i:n.dæ:.fi.neit	neit.fi:.dæ:.i:n	ai.dæ̌ɱ.fi.nʌit	neit.fi:.dæn.a:j
95.	*independent*	in.di.pæn.dənt	dʌm.pæn.di.i:n	in.di.pæn.dənt	dʌn.pæn.di:.i:n	in.di:.pæn.dənt	dʌn.pæn.di:.i:n
96.	*inflict*	iɱ.fleit	fleit.i:n	im.fleit	fleit.i:n	iŋ.fleit	fleikt.i:n
97.	*infuse*	im.fju:s	fju:s.i:n	iɱ.fju:s	fju:s.i:n	im.fju:s	fju:s.i:n
98.	*ink*	iŋk	kiŋ	i:ŋk	kiŋ	i:ŋk	k.i:n
99.	*inked*	i:ŋkt	kt.i:n	i:ŋkt	kt.i:n	i:ŋkt	kt.i:n
100.	*inks*	iŋs	siʜk	iŋs	s.i:ŋk	iŋs	s.i:ŋk
101.	*instinct*	in.sti:ŋkt	tiŋs.i:n	in.sti:ŋkt	stin.i:n	iŋ.sti:ŋt	sti:ŋkt.i:n
102.	*instrument*	i:n.stɹə.mʌn	mʌn.stɹa.i:n	i:ns.tʃə.mʌnt	mʌns.tʃə.i:n	i:ns.tʃə.mʌnt	mʌns.tʃʌ.i:n
103.	*i-Tunes*	ai.tjuns	tjuns.a:j	ai.tuns	tuns.a:j	a:j.tuns	tuns.a:j
104.	*jasmine*	dʒæs.min	min.dʒæs	dʒæs.min	mins.dʒæ	dʒa:s.mein	mi:ns.dʒa:
105.	*jumps*	dʒa:m.s	s.dʒa:mp	dʒa:m.s	s.dʒa:mp	dʒa:m.s	s.dʒa:mp
106.	*kept*	kæ.pt	pt.kæ	kæ.pt	pt.kæ	kæpt	pt.kæ
107.	*lapse*	læps.s	slæp	læps.s	slæp	læp.s	sp.læ:
108.	*lapsed*	lap.st	st.læp	læp.st	st.læp	læp.st	st.læp
109.	*larks*	la:ks	sla:k	la:ks	sla:k	la:ks	sla:k
110.	*lend*	læ:nd	də.læ:n	læ:nd	də.læn	læ:nd	də.læn
111.	*lift*	li:ft	fʌd.lei	li:ft	ft.li:	li:ft	ft.li:
112.	*lisp*	lejsp	py.li:s	leisp	pəs.li:	li:sp	pʌs.li:
113.	*lived*	li:ft	vɐl.li	le:ft	vd.li:	le:ft	vd.li:
114.	*lives*	laifs	slaif	laifs	slaif	laif.s	fs.lai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lɒ:k	kʌ.lɒ	lɒ:k	k.lɒː	lɒ:k	k.lɒː
116.	*log*	lɒ:g	goː	lɒ:g	gə.lɒː	lɒ:g	g.lɒː
117.	*lump*	la:mp	pə.la:m	la:mp	pla:m	la:mp	p.la:m
118.	*matched*	mæʧt	t͡ut.mæt	mætʃt	tʃt.mæ	mætʃt	tʃt.mæ
119.	*melt*	mæut	tæum	mæut	tə.mæu	mæut	tə.mæu
120.	*milk*	miuk	kə.miu	miuk	k.miu	meuk	k.miu
121.	*misquote*	mis.kwo:t	ko:t.mi:s	mi:s.kwɒ:t	kwɒ:t.mi:s	mi:s.kwɒ:t	kwɒ:t.mi:s
122.	*ounce*	a:ŋs	sa:ŋ	a:ŋs	s.a:ŋ	a:ŋs	s.a:ŋ
123.	*owns*	ɒ:ns	s.ɒ:n	ɒ:ns	s.ɒ:n	ɒ:ns	s.ɒ:n
124.	*ox*	ɒks	s.ɒː	ɒks	s.ɒːʔ	ɒks	ks.ɒː
125.	*participate*	paː.tiː.siː.peit	pei.si.tiː.paː	paː.tiː.siː.peit	pei.si.tiː.paː	paː.tiː.siː.peit	pei.si.tiː.paː
126.	*peacemaking*	pi:s.mei.ki:ŋ	kiŋ.mʌis.piː	pi:s.mʌi.ki:ŋ	kiŋ.mei.pi:s	pi:s.mʌi.ki:ŋ	kiŋ.mei.pi:s
127.	*play*	plʌi	leip	plʌi	leip	plʌi	leip
128.	*pray*	pɹei	ɹeip	pɹʌi	ɹeip	pɹei	ɹeip
129.	*presidency*	pɹæː.si.dən.siː	siː.dən.si.pɹeː	pɹæː.si.dən.siː	siː.dən.siː.pɹeː	pɹæː.siː.dʌn.siː	siː.dən.siː.pɹeː
130.	*puffs*	pa:fs	spa:f	pa:fs	spa:f	pa:fs	spa:f
131.	*raised*	ɹʌist	stɹʌi	ɹʌist	st.ɹei	ɹeist	st.ɹei
132.	*range*	ɹeindʒ	dʒu.ɹeŋ	ɹe:ŋtʃ	tʃu.ɹe:ŋ	ɹe:ntʃ	tʃ.ɹein
133.	*recommend*	ɹæ.kə.ma:nd	mæŋ.kəm.ɹaː	ɹæː.kə.ma:nd	mæn.kəŋ.ɹaː	ɹæː.kə.ma:nd	mæn.kən.ɹaː
134.	*recruiter*	ɹiː.kɹuː.təː	təː.kɹuː.ɹʷiː	ɹʷiː.kɹuː.taː	təː.kɹuː.ɹʷiː	ɹiː.kɹuː.taː	taː.kɹuː.ɹʷiː
135.	*refrigerator*	ɹiː.fɹiː.dʒo.ɹʌi.təː	təː.ɹəː.dʒəː.fiː.ɹʷiː	ɹiː.fɹiː.dʒə.ɹei.təː	təː.ɹei.dʒʷiː.fɹiː.ɹʷiː	ɹiː.fɹiː.dʒu.ɹei.təː	taː.ɹei.dʒʌ.fɹiː.ɹʷiː
136.	*relationship*	ɹiː.lʌi.ʃən.ʃuip	ʃʷi:p.ʃən.lʌi.ɹiː	ɹiː.lʌi.ʃən.ʃʷi:p	ʃi:p.ʃʌn.lʌi.ɹiː	ɹiː.lei.ʃən.ʃʷi:p	ʃi:p.ʃʌn.lʌi.ɹiː
137.	*representative*	ɹeː.pɹi.sæn.tə.ti:f	ti:f.təː.sæm.pɹeid.ɹiː	ɹæ.pɹiː.sæn.tə.ti:f	ti:f.təː.sæm.pɹi.ɹiː	ɹæ.pɹiː.sæn.tə.ti:f	ti:f.təː.sæm.pu.ɹiː

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹaːʃt	ʃt.ɹaː	ɹaːʃt	ʃt.ɹaː	ɹaːʃt	ʃt.ɹaː
139.	*scratch*	skɹætʃ	tʃʌs.kɹæt	skɹætʃ	tʃs.kɹæ	skɹætʃ	tʃus.kɹæ
140.	*scree*	skɹiː	kɹiːs	skɹiː	kɹiːs	skɹiː	kɹiːs
141.	*segment*	sæg.mʌnt	mʌn.sæg	sæg.mʌnt	mʌnd.sæg	sæg.mʌnt	mʌnt.sæg
142.	*senseless*	sæns.leːs	lis.sæns	sæns.leːs	lis.sæns	sæns.leːs	liːs.sæns
143.	*sequence*	siː.kwʌns	kwʌn.siː	siː.kwʌns	kwʌns.siː	siː.kwʌns	kwʌns.siː
144.	*shameless*	ʃeim.leːs	lis.ʃeim	ʃeim.leːs	lis.ʃeim	ʃeim.leːs	lis.ʃeim
145.	*shelve*	ʃauf	fu.ʃau	ʃauf	f.ʃau	ʃauf	f.ʃau
146.	*shelved*	ʃauft	ft.ʃau	ʃauft	vd.ʃau	ʃauft	ft.ʃau
147.	*skate*	skeit	tʌs.gei	skʌit	t.skei	skeit	t.geis
148.	*skating*	skʌi.tiŋ	tiŋ.skei	skei.tiŋ	tiːŋ.skei	skʌi.tiːŋ	tiːŋ.skʌi
149.	*slope*	sloup	pi.slʌu	slʌup	p.slʌu	slʌup	p.slʌu
150.	*small*	smɒː	mɒːs	smɒː	mɒːs	smɒː	mɒːs
151.	*smooth*	smuːs	smuːs	smuːs	smuːs	smuːs	smuːs
152.	*snatch*	snætʃ	t͡næs	snætʃ	tʃs.næ	snatʃ	natʃ.s
153.	*spa*	spaː	baːs	spaː	baːs	spaː	baːs
154.	*spare*	speː.ə	peː.as	speː.ʌ	beː.as	speː.a	beː.as
155.	*sphere*	sfeː.aː	feː.as	sfeː.a	feː.as	sfeː.ə	feː.as
156.	*spiritual*	spiː.ɹi.tʃʌu	tʃʌu.ɹiː.piːs	spiː.ɹiː.tʃʌu	tʃʌu.ɹiː.spiː	spiː.ɹiː.tʃʌu	tʃʌu.ɹiː.spiː
157.	*splendid*	splæn.deit	dis.plæn	splæn.diːt	diːd.splæn	splæn.deid	dis.plæn
158.	*split*	spleit	bleit.s	spleit	ts.pliːt	spliːt	blits
159.	*spoil*	spɒ.jʌu	bɒ.jʌus	spɒ.jʌu	bɒ.jʌus	spɒ.jʌu	bɒ.jʌus
160.	*spray*	spɹʌi	pɹʌis	spɹʌi	bɹʌis	spɹei	bɹʌis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	spɹeiŋ	pɹiŋs	spɹeiŋ	bɹiŋs	spɹeiŋ	bɹiŋs
162.	*springs*	spɹiːŋs	spɹiŋs	spɹiŋs	spɹeŋs	spɹeːŋs	spɹeːŋs
163.	*squeeze*	skwiːs	skwiːs	skwiːs	skwiːs	skwiːz	zu.kwiː.is
164.	*stain*	steːŋ	tæns	steiŋ	dæŋs	steiŋ	dæŋs
165.	*star*	staː	taːs	staː	daːs	staː	daːs
166.	*string*	stɹiːŋ	dʒuiŋs	stɹiːŋ	dʒuiŋs	stɹiːŋ	dʒiŋs
167.	*stupid*	stjuː.pitʰ	pis.diu	stjuː.pitʰ	pis.diu	stjuː.pitʰ	piːd.stuː
168.	*suppose*	sʌ.pous	pous.sʌp	sʌ.pʌus	pous.saːp	sʌ.pʌus	pous.saːp
169.	*swim*	swim	wims	swim	wims	swim	wims
170.	*text*	tækst	ts.tæ	tækst	təːs.tæ	tækst	tʌks.tæ
171.	*thankful*	θæŋ.fou	fʌu.sæŋk	θæŋ.fou	fou.θæŋk	sæŋk.fʌu	fou.sæŋk
172.	*trenched*	tʃæntʃt	tʃut.tʃeːŋ	tʃæntʃt	tʃt.tʃeːn	tʃæntʃt	tʃt.tʃæjn
173.	*tweet*	twiːt	tiːwt	twiːt	wiːt	twiːt	tu.twiː
174.	*underpaid*	aːn.dəː.peːjtʰ	pei.də.aːŋ	aːŋ.dəː.peːjtʰ	pei.dəː.aːŋ	aːn.də.pʌːjtʰ	pei.dəː.aːn
175.	*understand*	ʌn.də.staːnd	stæn.də.ʌn	aːn.də.stæːnd	dæn.dʌs.aːn	ʌn.də.staːnd	stæn.dəː.aːn
176.	*urge*	əːdʒ	n̥yː	əːdʒ	dʒ.əː	əːdʒ	dʒ.əː
177.	*Welsh*	wauʃ	ʃwau	wauʃ	ʃ.wau	wauʃ	ʃ.wau
178.	*whereabout*	weː.ɹə.baut	bau.ɹə.weə	weː.ɹe.baut	baut.ɹʷə.weə	weː.ɹe.baut	baut.ɹʌ.weə
179.	*wolf*	wouf	f.wou	wouf	f.wou	wʌuf	f.wʌu
180.	*woodland*	wuːd.lənd	lʌnd.wuːd	wuːd.ləntʰ	lʌnd.wuːd	wuːd.lənd	lʌnd.wuːd

X. GZ-F-23-03 (Transcriptions in IPA)

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	**Tested words**	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
1.	*afraid*	ə.fɹeid	də.fɹeid	ə.fɹeid	fɹeid.ə	ə.fɹeid	fɹeid.ə
2.	*age*	eitʃ	tʃ.ei	eitʃ	dʒ.ei	eitʃ	dʒ.ei
3.	*Alps*	elps	s.elp	elps	s.elp	elps	ps.el
4.	*amuse*	ə.mius	mis.ə	ə.mius	mius.ə	ə.mius	mius.aː
5.	*anguish*	en.gwiʃ	ʃwi.gɹi.en	eŋ.gwiʃ	gwiʃ.en	eŋ.gwiʃ	gwiʃ.en
6.	*anklet*	enk.lit	lit.eŋ	en.klit	klit.en	enk.lit	lit.enk
7.	*ant*	ent	ten	ent	ten	ent	t.en
8.	*approve*	ə.pɹuf	pɹuf.ə	ə.pɹuf	pɹuf.əː	ə.pɹuf	pɹuf.əː
9.	*ask*	aːsk	kəs.aː	aːsk	sk.aː	aːsk	ks.aː
10.	*asked*	askt	təks.aː	aːskt	skt.aː	aːskt	kt.aːs
11.	*asks*	aːsts	tss.aː	aːsk	kəs.aː	aksts	tss.aː
12.	*bangs*	bens	sben	bens	sben	bens	sben
13.	*begged*	bekt	dək.be	bekt	ktbe	begd	gdbe
14.	*begs*	beks	sbek	beks	skbe	begs	gsbe
15.	*blast*	blast	stblaː	blast	stblaː	blast	stblaː
16.	*bled*	bled	eb	blet	tble	blet	dep
17.	*bloom*	bluːm	muːn	bluːm	uːm	bluːm	muːm
18.	*blunt*	blʌnt	tʌmb	blʌnt	tʌn	blʌnt	tʌmp
19.	*blur*	bləː	əːb	bləː	əː	bləː	əː
20.	*brief*	bɹif	fɹi	bɹif	fbɹiː	bɹiːf	fbɹiː
21.	*Britain*	bɹi.tən	tʌm.bɹi	bɹi.tən	tʌm.bɹi	bɹi.tən	təm.bɹi
22.	*bronze*	bɹans	sbɹan	bɹanz	zbɹan	bɹants	tsbɹan

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
23.	*build*	biud	dbiu	biud	dbiu	biud	dbiu
24.	*bulb*	bʌlb	bʌlp	bʌlb	bʌlp	bʌlb	bʌlp
25.	*bulbs*	bʌls	sbʌl	bʌls	sbʌl	bʌls	sbʌl
26.	*cashback*	kæʃ.bæk	bæʃ.kæ	kæʃ.bæk	bækʃ.kæ	kæʃ.bæk	bæk.kæʃ
27.	*clarify*	kle.ɹi.fai	fɹai.ɹi.ke	klæ.ɹi.fai	fai.ɹi.kæ	klæ.ɹi.fai	fai.ɹi.klæ
28.	*Clark*	kla:k	kla:k	kla:k	kə.klaː	kla:k	k.klaː
29.	*clear*	kliəɹ	əɹ.kli	kə.li.ə	liək	kli.ə	liək
30.	*cliff*	kli:f	fkliː	kə.li:f	fkliː	kli:f	fkliː
31.	*close*	klous	sklou	klous	klous	klous	sklou
32.	*closure*	klo.ʃe	ʃe.klou	klou.ʒe	ʒe.klou	klou.ʒe	ʒe.kou
33.	*clothing*	klou.θiŋ	θiŋ.kou	klou.θiŋ	θiŋ.kou	klo.θiŋ	θiŋ.klo
34.	*clubbed*	klʌpt	də.klʌp	klʌpt	ptklʌp	kla:pt	ptkla:p
35.	*Constantine*	kons.tən.tin	tin.tən.kons	kons.tən.tin	tin.tən.kons	kons.tən.tin	tin.tən.kons
36.	*corpse*	kops	skop	kops	skop	kops	pəs.ko
37.	*crawl*	kloː	lo:k	kɹoː	loː	kɹoː	loː
38.	*crisp*	kɹisp	pəs.kɹi	kɹisp	spkɹi	kɹisp	spkɹi
39.	*crow*	kɹau	au	kɹau	au	kɹau	au
40.	*crown*	kɹa:m	a:wk	kɹaun	aun	kɹaŋ	aun
41.	*cry*	kɹai	ai	kɹai	ai	kɹai	ai
42.	*cube*	kiup	bkiu	kiup	pkiu	kiup	pkiu
43.	*digest*	dʌi.dʒest	dʒes.dʌi	dʌi.dʒest	dʒest.dʌi	dʌi.dʒest	dʒest.dʌi
44.	*disband*	dis.bend	ben.dis	dis.bent	ben.dis	dis.bent	ben.dis
45.	*disclaim*	dis.kə.leim	lein.kə.dis	dis.kleim	kə.leim.dis	dis.kleim	kə.leim.dis

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
46.	*discuss*	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis	dis.gʌs	gʌs.dis
47.	*dumped*	dʌm.pit	pi.dʌm	dʌm.pit	pit.dʌm	dʌm.pit	pit.dʌm
48.	*east*	ist	st.iː	iːst	st.iː	iːst	st.iː
49.	*eats*	its	ts.i	iːts	ts.iː	iːts	ts.iː
50.	*Ed*	ed	de	eːt	deː	eːt	de
51.	*edge*	etʃ	dʒi.eː	etʃ	tʃ.e	etʃ	tʃ.e
52.	*elf*	ef	fv.e	elf	f.el	elf	f.el
53.	*else*	els	s.el	els	s.el	els	s.el
54.	*elves*	elfs	fs.el	elfs	fs.el	elfs	fs.el
55.	*encourage*	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in	in.kʌ.ɹitʃ	ɹitʃ.kʌ.in
56.	*encouraging*	in.kʌ.ɹi.dʒiŋ	dʒiŋ.ɹi.kʌ.in	in.kʌ.ɹi.dʒiŋ	dʒən.ɹi.kʌ.in	in.kʌ.ɹi.dʒin	dʒən.ɹi.kʌ.in
57.	*English*	iŋg.liʃ	liʃ.iŋk	iŋg.liʃ	liʃ.iŋk	iŋg.liʃ	liʃ.iŋk
58.	*ex-con*	es.kon	kon.es	es.kon	kon.eks	es.koŋ	ko.eks
59.	*excuse*	is.gius	gius.iː	is.gius	gius.is	is.gius	gius.is
60.	*exhale*	iks.hel	hel.iks	iks.hel	hel.iks	iks.hel	hel.iks
61.	*explode*	is.bloud	bloud.is	is.bloud	bloud.is	is.bloud	bloud.is
62.	*fabric*	fæ.bɹik	bɹi.fæ	fæ.bɹik	bɹik.fæ	fæ.bɹik	bɹik.fæ
63.	*fact*	fækt	ktfæ	fækt	ktfæ	fækt	ktfæ
64.	*famed*	feimt	də.fein	feimt	də.fein	feimd	dfeim
65.	*fed*	fet	def	fet	dfe	fet	de
66.	*film*	film	ilm	fiu	iun	fium	ium
67.	*fish*	fiʃ	ʃfiː	fiʃ	ʃi.fi	fiʃ	ʃfiː
68.	*flap*	flæp	pə.flæ	flæp	pflæ	flæp	pflæ

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
69.	*flirt*	fləːt	təːfl	fləːt	tfləː	fləːt	təːf
70.	*flu*	fluː	uːf	fluː	uː	fluː	uːf
71.	*fly*	flai	ai	flai	ai	flai	ai
72.	*foolish*	fu.liʃ	liʃ.fu	fuː.liʃ	ʃli.fu	fuː.liʃ	ʃli.fu
73.	*frank*	fɹenk	kfɹen	fɹenk	kfɹen	fɹeŋk	kfɹen
74.	*Franks*	fɹenks	sfɹeŋ	fɹenks	sfɹenk	fɹenks	kəs.fɹen
75.	*free*	fɹiː	iːf	fɹiː	iː	fɹiː	iː
76.	*freshness*	fɹeʃ.nis	nis.ʃi.fɹe	fɹeʃ.nis	nis.ʃi.fɹe	fɹeʃ.nis	nis.fɹeʃ
77.	*friend*	fɹend	enf	fɹend	en	fɹend	denf
78.	*fringe*	fɹintʃ	dʒei.fɹiŋ	fɹintʃ	dʒi.fɹiŋ	fɹintʃ	tʃfɹiŋ
79.	*games*	gems	sgeim	gems	sgeim	geːms	sgeːm
80.	*gasped*	gasp	pəs.gaː	gaspt	ptgaːs	gaːspt	ptgaːs
81.	*gasps*	gasps	spə.gaː	gasps	pəs.gaː	gaːsps	pəs.gaːs
82.	*gave*	geif	fgei	geif	fgei	geif	fgei
83.	*glue*	gluː	luː	gluː	uː	g^{w}luː	uː
84.	*grab*	gɹeb	bɹep	gɹeb	bgɹe	gɹeb	beg
85.	*grant*	gwʌnt	tgɹʌn	gɹʌnt	tgɹʌn	gɹʌnt	tgɹʌn
86.	*grape*	gɹeip	i.gɹei	gɹeip	pgɹei	gɹeip	pgɹei
87.	*help*	hel.pə	pə.hel	help	pə.hel	help	pə.hel
88.	*helped*	hel.pə	pə.hel	helpt	təp.hel	helpt	pthel
89.	*hobnob*	hop.nop	nop.ho	hob.nob	nop.ho	hob.nob	nop.ho
90.	*implore*	im.pɹoː	pɹoː.in	im.poː	pɹo.in	im.ploː	pɹoː.iːm
91.	*improve*	im.pɹuf	pɹuf.in	im.pɹuf	pɹuf.in	im.pɹuːf	pɹuf.in

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
92.	*inch*	intʃ	tʃi.iːn	intʃ	tʃ.iŋ	intʃ	tʃ.iŋ
93.	*increasing*	in.kɹi.siŋ	siŋ.kɹi.in	in.kɹi.ziŋ	siŋ.kɹi.in	in.kɹi.siŋ	siŋ.kɹi.in
94.	*indefinite*	in.de.fən.ni	ni.fə.de.in	in.de.fə.nit	nit.fə.de.in	in.de.fə.nit	nit.fi.de.in
95.	*independent*	in.di.pen.dənt	dəm.pen.di.in	in.di.pen.dənt	dəm.pen.di.in	in.di.pen.dənt	dəm.pen.di.in
96.	*inflict*	in.fligt	tə.flik.in	in.flikt	flikt.in	in.flikt	flikt.in
97.	*infuse*	in.fius	fius.in	in.fius	fius.in	in.fius	fius.iŋ
98.	*ink*	iŋk	kiŋ	iŋk	kiŋ	iŋk	kin
99.	*inked*	in.kit	kit.in	iŋ.kit	kit.in	iŋkt	kt.in
100.	*inks*	iŋs	siŋ	iŋks	s.iŋ	iŋks	s.iŋ
101.	*instinct*	ins.diŋkt	diŋk.in	ins.diŋk	diŋk.ins	ins.diŋk	diŋk.ins
102.	*instrument*	ins.dɹə.mənt	mən.sdɹʌ.in	ins.tɹə.mənt	mən.sdɹʌ.in	ins.tɹʌ.mənt	mən.sdɹʌt.in
103.	*i-Tunes*	ʌi.tuns	sən.tu.ʌi	ʌi.tuns	tuns.ai	ʌi.tuns	tuns.ai
104.	*jasmine*	dʒæs.min	mins.dʒæ	dʒes.min	mins.dʒe	dʒæs.min	mins.dʒæ
105.	*jumps*	dʒʌms	sdʒʌm	dʒoms	sdʒom	dʒʌ.məs	sdʒʌmp
106.	*kept*	kept	tpke	kept	ptke	kept	ptke
107.	*lapse*	læps	slæp	læps	slæ	læps	pəs.læ
108.	*lapsed*	læps	slæp	læps	dəs.læp	læpst	sdlæp
109.	*larks*	laks	sklaː	laks	sklaː	laːks	kəs.laː
110.	*lend*	lent	dlen	lend	dlen	lend	dlen
111.	*lift*	lift	tə.lif	lift	təf.liː	lift	təf.liː
112.	*lisp*	lisp	pəs.li	lisp	pəs.li	lisp	pəs.liː
113.	*lived*	lifd	diːf	lifd	dəf.li	lifd	ftliː
114.	*lives*	laifs	slaif	laifs	slaif	laifs	sflai

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
115.	*lock*	lok	klo	lok	k.lo	lok	k.lo
116.	*log*	lok	go	loːk	goː	loːk	goː
117.	*lump*	lʌmp	plʌm	lʌmp	p.lʌm	lʌmp	p.lʌm
118.	*matched*	me.tʃit	tʃi.met	me.tʃit	tʃit.me	me.tʃit	tʃit.me
119.	*melt*	melt	tə.meːl	melt	tmel	melt	tmel
120.	*milk*	miuk	kmiu	miuk	kmiu	miuk	kmiu
121.	*misquote*	mis.kout	kout.mis	mis.kɹout	kɹout.mis	mis.kɹout	kɹout.mis
122.	*ounce*	oŋs	s.oŋ	ons	s.oːm	oːns	s.oːŋ
123.	*owns*	oŋs	s.oŋ	oŋs	s.oŋ	oŋs	s.oŋ
124.	*ox*	oks	kəs.oː	oks	soː	oːks	ks.oː
125.	*participate*	pʌ.ti.si.peit	pei.ti.si.paː	pa.ti.si.peit	pei.ti.si.paː	pʌ.ti.si.peit	pei.ti.si.pʌː
126.	*peacemaking*	pis.mei.kiŋ	kiŋ.mei.sɯ.pi	pis.mei.kiŋ	kiŋ.meis.piː	pis.mek.kiŋ	kem.meis.piː
127.	*play*	pɹei	ei	pɹei	ei	pɹei	ei
128.	*pray*	pɹei	ei	pɹei	ei	pɹei	ei
129.	*presidency*	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe	pɹe.si.dən.si	si.dən.si.pɹe
130.	*puffs*	pufs	sɯf.puː	pufs	spuf	pufs	spuː
131.	*raised*	ɹeisd	dəs.ɹei	ɹeisd	dəs.ɹei	ɹeisd	dəs.ɹei
132.	*range*	ɹentʃ	dʒi.ɹen	ɹeintʃ	dʒi.ɹein	ɹeintʃ	tʃɹeŋ
133.	*recommend*	ɹe.kə.ment	men.kə.ɹe	ɹe.kəm.mənd	men.kən.ɹe	ɹe.kə.mənd	men.kə.ɹe
134.	*recruiter*	ɹi.ku.tə	tə.ku.ɹi	ɹi.kɹu.tə	tə.kɹuː.ɹi	ɹi.kuː.tə	tə.kɹuː.ɹi
135.	*refrigerator*	ɹi.fɹi.dʒu.ɹei.təɹ	tə.ɹei.dʒi.fɹi.ɹi	ɹi.fi.dʒu.ɹei.təɹ	tə.ɹei.dʒi.fɹi.ɹi	ɹi.fɹi.dʒi.ɹei.tə	tə.ɹei.dʒi.fɹi.ɹi
136.	*relationship*	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃi.ʃən.lei.ɹi	ɹi.lei.ʃən.ʃip	ʃip.ʃən.lei.ɹi
137.	*representative*	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe	ɹe.pɹi.sen.tə.tif	tif.tə.sem.pɹi.ɹe

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
138.	*rushed*	ɹʌ.ʃit	ʃit.ɹʌ	ɹʌʃd	ʃt.ɹʌ	ɹʌʃd	ʃt.ɹʌ
139.	*scratch*	sgɹetʃ	tʃis.gɹe	sgɹetʃ	tʃis.gɹe	sgɹetʃ	tʃsgɹe
140.	*scree*	sgɹiː	iːs	sgɹiː	iː	sgɹiː	gɹis
141.	*segment*	sek.mənt	mənt.sek	seg.mənt	mənt.sek	seg.mənt	mənt.sek
142.	*senseless*	sens.nis	nis.sen	sens.nis	nis.sens	sens.nis	nis.ssen
143.	*sequence*	si.kwəns	skwən.sit	sik.kwəns	kwəns.si	sik.kwəns	kwəns.si
144.	*shameless*	ʃeim.nis	lis.ʃeim	ʃeim.nis	lis.ʃeim	ʃeim.lis	lis.ʃeim
145.	*shelve*	ʃelf	fʃel	ʃelf	f.ʃel	ʃelf	f.ʃel
146.	*shelved*	ʃjaft	ftʃel	ʃelft	ftʃel	ʃelfd	ftʃel
147.	*skate*	sgeit	tə.geis	sgeit	tə.sgei	sgeit	tə.sgei
148.	*skating*	sgeː.tiŋ	tiŋ.geis	sgei.tiŋ	tens.gei	sgei.tiŋ	tens.gei
149.	*slope*	sloup	pə.lous	sloup	pə.slou	sloup	pə.slou
150.	*small*	smoːɹ	loːs	smoːɹ	loː	smoːɹ	loːs
151.	*smooth*	smuθ	θmus	smuθ	θsmu	smuːθ	θu.smuː
152.	*snatch*	snetʃ	tʃi.nes	snetʃ	tʃis.ne	snetʃ	tʃis.ne
153.	*spa*	sbaː	baːs	sbaː	baːs	sbaː	baːs
154.	*spare*	sbeəɹ	beəɹs	sbe.ə	beəs	sbe.ə	be.əs
155.	*sphere*	speəɹ	beəɹs	sfi.ə	fi.əs	sbi.ə	bi.əs
156.	*spiritual*	sbi.ɹi.tʃou	tʃou.ɹi.sbi	sbi.ɹi.tʃou	tɕou.ɹi.sbi	sbi.ɹi.tʃou	tʃou.ɹi.sbi
157.	*splendid*	sbɹen.dit	di.bɹens	sblen.dit	di.sbɹen	sbɹen.dit	di.sbɹen
158.	*split*	sblit	tə.sbɹi	sbiut	tə.sbiu	sblit	tə.sbli
159.	*spoil*	sboil	ois	sbo.jəl	bo.jəls	sbo.jəl	bo.jəls
160.	*spray*	sbɹei	ei	sbɹei	bɹeis	sbɹei	ei

		First utterance attempt		Second utterance attempt		Third utterance attempt	
No.	***Tested words***	**Normal-1**	**Reverse-1**	**Normal-2**	**Reverse-2**	**Normal-3**	**Reverse-3**
161.	*spring*	sbɹiŋ	bɹiŋs	sbɹiŋ	bɹiŋs	sbɹiŋ	ɹimbs
162.	*springs*	sbliŋs	sbliŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs	sbɹiŋs
163.	*squeeze*	sgwiz	zgwiː	sgwiːz	zgwis	sgwiz	zsgwiː
164.	*stain*	sdein	eins	sdeŋ	deŋs	sdeŋ	deŋs
165.	*star*	sdaːɹ	daːɹs	sdaːɹ	aːɹ	sdaːɹ	aːts
166.	*string*	sdɹiŋ	dɹiŋs	sdɹin	dɹins	sdɹiŋ	dɹiŋs
167.	*stupid*	sdju.pit	pit.sdju	sdju.pit	pi.sdju	sdju.pit	pi.sdjuː
168.	*suppose*	sə.pous	pous.sə	sə.pous	pous.sə	sə.pous	pous.sʌt
169.	*swim*	swim	wims	swim	yum	swim	wims
170.	*text*	test	təs.te	teks	kəs.te	tekts	kəs.te
171.	*thankful*	θenk.fo	fo.θen	θenk.fou	fok.θen	θenk.fou	fou.θenk
172.	*trenched*	tɹen.tʃid	tɹit.tʃen	tɹen.tʃid	tɹit.tɹen	tɹen.tɹit	tɹit.tɹen
173.	*tweet*	twiːt	tiː	tswiːt	tʃyː	twiːt	tiː
174.	*underpaid*	ʌn.də.peit	də.pei.ʌn	ʌn.dəɹ.pei	pei.dəɹ.ʌn	ʌn.dəɹ.peid	peid.ʌn.dəɹ
175.	*understand*	ʌn.dəɹ.sdæn	dæns.dəɹ.ʌn	ʌn.dəɹ.sdænd	sdæn.dəɹ.ʌn	ʌn.dəɹ.sdænd	sdæn.dəɹ.ʌn
176.	*urge*	əːtʃ	dʒi.əː	əːtʃ	dʒ.əː	əːtʃ	tʃ.əː
177.	*Welsh*	welʃ	ʃ.wel	welʃ	ʃ.wel	welʃ	ʃ.wel
178.	*whereabout*	weə.ə.baut	baut.ə.weə	we.ə.ə.baut	ə.baut.weə	weə.ə.baut	ə.baut.weə
179.	*wolf*	wuːf	f.wuː	wuːf	f.wuː	wuːf	f.wuː
180.	*woodland*	wud.len	lent.wut	wud.lend	lend.wut	wud.lent	lent.wut

CURRICULUM VITAE

Academic qualifications of the thesis author, Mr. QIN Chuan:

- Received the degree of Bachelor of Arts in English from Guangxi Normal University, June 2009.
- Received the degree of Master of Arts in Language Studies from Hong Kong Baptist University, November 2011.

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