UNIVERSITAS INDONESIA

OPTIMAL SUBSTITUTIONS OF DENTAL FRICATIVES BY INDONESIAN LEARNERS OF ENGLISH

SKRIPSI

BERNARD AMADEUS JAYA

0806467540

FAKULTAS ILMU PENGETAHUAN BUDAYA

PROGRAM STUDI INGGRIS

DEPOK

FEBRUARI 2012

SURAT PERNYATAAN BEBAS PLAGIARISME

Saya yang bertanda tangan di bawah ini dengan sebenarnya menyatakan bahwa skripsi ini saya susun tanpa tindakan plagiarisme sesuai dengan peraturan yang berlaku di Universitas Indonesia.

Jika kemudian hari ternyata saya melakukan tindakan Plagiarisme, saya akan bertanggung jawab sepenuhnya dan menerima sanksi yang dijatuhkan oleh Universitas Indonesia kepada saya.

Jakarta, 3-02-2012

HALAMAN PERNYATAAN ORISINALITAS

Skripsi ini adalah hasil karya saya sendiri,

dan semua sumber baik yang dikutip maupun dirujuk

telah saya nyatakan dengan benar.

Nama	**: Bernard Amadeus Jaya**
NPM	**: 0806467540**
Tanda Tangan	**:**
Tanggal	**: 3-02-2012**

HALAMAN PENGESAHAN

Skripsi ini diajukan oleh :
Nama : Bernard Amadeus Jaya
NPM : 0806467540
Program Studi : Inggris
Judul Skripsi : Optimal Substitutions of Dental Fricatives by Indonesian Learners of English

ini telah berhasil dipertahankan di hadapan Dewan Penguji dan diterima sebagai bagian persyaratan yang diperlukan untuk memperoleh gelar Sarjaa Humaniora pada Program Studi Inggris, Fakultas Ilmu Pengetahuan Budaya, Universitas Indonesia.

DEWAN PENGUJI

Pembimbing : Diding Fahrudin, M.A. ( )

Penguji : Dr. Grace Wiradisastra, M. Ed.

Penguji : Sunu Wasono, M.Hum. ( )

Ditetapkan di : Depok
Tanggal : 12 Januari 2012

Oleh
Dekan
Fakultas Ilmu Pengetahuan Budaya
Universitas Indonesia

Dr. Bambang Wibawarta
Nip. 196510231990031002

ACKNOWLEDGEMENT

The completion of this undergraduate thesis would not be possible without the help of many individuals, institutions, and groups of people. They have been of great assistance to me. This undergraduate thesis is one of the prerequisites of attaining the S.Hum (Sarjana Humaniora) degree from English Studies Program, Faculty of Humanities, University of Indonesia. In accordance, I would like to dedicate this section of the thesis solely to extend my gratitude and give my most sincere thanks to:

(1) Diding Fahrudin S.S., M.A. As my supervisor who has been endlessly patient, supportive, and enthusiastic in the bumps and falls of thesis writing. As a lecturer, he has always been the infinite well of inspiration.

(2) Gietty Tambunan S.Hum, M.A. Another source of encouragement who has been helping me with the acquirement of important references vital to the undergraduate thesis.

(3) My brother, Edo Sebastian Jaya S.Psi. M.Psi. I would like to give credits to him for the many discussions done on the topic, and for patiently instructing me on the subject of statistics.

(4) Lecturers who have contributed to the creation of this thesis, in particular Mrs Marti Fauziah S.S, M.Hum and Mr Cornelius Meilala S.S., M.A.

(5)English Department friends and family (especially Dad) who have been extremely supportive in the hectic times one had to go through, no one could ask for better encouragement. Thanks guys!

No amount of gratitude could ever repay the kindness and contribution of those listed above and those who have supported me in the creation of this undergraduate thesis.

Depok, January 2012

Bernard Amadeus
Jaya

HALAMAN PERNYATAAN PERSETUJUAN PUBLIKASI TUGAS AKHIR UNTUK KEPENTINGAN AKADEMIS

Sebagai sivitas akademik Universitas Indonesia, saya yang bertanda tangan dibawah ini

Nama	: Bernard Amadeus Jaya
NPM	: 0806467540
Program Studi	: Inggris
Departemen	: Linguistik
Fakultas	: Ilmu Pengetahuan Budaya
Jenis Karya	: Skripsi

demi pengembangan ilmu pengetahuan, menyetujui untuk memberikan kepada Universitas Indonesia **Hak Bebas Royalti Noneksklusif *(Non-Exclusive Royalty Free Right*)** atas karya saya yang berjudul: Substitusi Optimal Bunyi Dental Frikatif Inggris oleh Pelajar Indonesia

Beserta perangkat yang ada (jika diperlukan). Dengan Hak Bebas Royalti Non Eksklusif ini Universitas Indonesia berhak menyimpan, mengalihmediakan/formatkan, mengelola dalam bentuk pangkalan data (database), merawat, dan memublikasikan tugas akhir saya tanpa meminta izin dari saya selama tetap mencamtumkan nama saya sebagai penulis/pencipta dan sebagai pemilik Hak Cipta.

Demikian pernyataan ini saya buat dengan sebenarnya,

Dibuat di: Depok, Indonesia
Pada Tanggal : 3-02-2012
Yang menyatakan,

Bernard Amadeus Jaya

ABSTRAK

Nama : Bernard Amadeus Jaya

Program Studi : Inggris

Judul : Substitusi Optimal Bunyi Dental Frikatif Inggris oleh Pelajar Indonesia

Pelajar Indonesia menghadapi banyak kesulitan dalam pelafalan bunyi-bunyi bahasa Inggris. Akan tetapi, dua segmen khususnya, memiliki tingkat kesilapan yang sangat tinggi. Beberapa studi oleh peneliti Indonesia telah memperlihatkan bahwa dental frikatif dalam bahasa Inggris /θ/ dan /ð/ adalah bunyi yang paling sulit dilafalkan oleh penutur asli bahasa Indonesia speakers (lihat Pardede 2007, Tiono & Yostanto 2008). Hal yang menarik adalah bahwa fenomenon yang sama terjadi untuk penutur asli bahasa lainnya (penutur bahasa Belanda, contohnya, lihat Wester, et al. 2007). Cara untuk mengatasi kesulitan ini salah satunya adalah untuk menggantikan segmen tersebut. Penelitian ini menelusuri bagaimana pelajar Indonesia menggantikan dental frikatif bahasa Inggris dengan fonem lain, apa yang digunakan untuk menggantikannya, dan mengapa digantikan. Berbeda dengan publikasi lainnya yang menggunakan mahasiswa sebagai subyek, participan penelitian ini tidak memiliki kompetensi bahasa inggris yang tinggi dan berusaha untuk merepresentasi populasi Indonesia secara akurat. Ada limabelas (15) orang subyek yang diambil dari sebuah kelas General English. Participan memiliki perbedaan dalam umur, jenis kelamin, dan pekerjaan. Eksperimen ini menggunakan tiga macam ujian untuk mengumpulkan data-mendeskripsikan gambar, membaca kalimat, dan membaca daftar kata. Tuturan direkam lalu dianalisis secara manual sebelum dikonfirmasi hasil transkripnya dengan sebuah program data analisis fonetik yang bernama PRAAT. Lalu hasil transkrip dianalisis dengan Optimality Theory untuk menjelaskan latar belakang penggunaan substitusi yang optimal. Hasil penelitian memperlihatkan bahwa orang Indonesia secara umum menggunakan dua fonem yang berbeda untuk mensubstitusikan dental frikatif dalam bahasa Inggris, tetapi yang menarik adalah bahwa posisi segmen dental frikatif (voiced) dalam kata menentukan substitusinya.

Kata Kunci:

Dental frikatif, Optimality Theory, analisis kesilapan, fonetik, substitusi

ABSTRACT

Name : Bernard Amadeus Jaya

Major : English Studies Program

Title : Optimal Substitutions of English Dental Fricatives by Indonesian Learners

While Indonesian students encounter plenty of difficulties in pronouncing English sounds, two segments, in particular, are notorious for its rate of error. Recent studies by Indonesian scholars have shown that the dental fricatives of English /θ/ and /ð/ have been rated as some of the most difficult segments to be pronounced by Indonesian speakers (see Pardede 2007, Tiono & Yostanto 2008). This is surprisingly true for speakers of several other languages as well (Dutch, for example, see Wester, et al. 2007). One of the ways to deal with a difficult segment is to replace them. This research looks at how Indonesian learners of English replace dental fricatives with other phonemes, what they use to replace those segments, and why. Contrary to related publications on error analysis that utilizes university students as their subjects, the subjects here are not advanced in English and strive to represent the Indonesian population more accurately. The participants are fifteen (15) students in a General English class. They vary in age, gender, and occupation. The experiment uses three tests to gather data to ensure maximum validity- describing pictures, reading sentences, and reading from a word list. The speech data is recorded and then analyzed manually before it is confirmed using a computer phonetic data analysis program called PRAAT prior to an Optimality Theory to investigate the background of the optimal substitute. Results show that Indonesians generally use two different phonemes to replace the English dental fricatives, but the interesting finding is that the position for the voiced dental fricative determines its substitute.

Keywords:

Dental fricative, optimality theory, error analysis, phonetics, substitution

CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1.1 Background

Communication between individuals and groups is one of the basic needs of human beings. In a global context, English assumes the power as the international world language. Besides its extensive distribution, English is also used as a second or foreign language by numerous countries (Phillipson, 1992). Indonesia, in this context, is a country that applies EFL or English as a Foreign Language where–though English does not have a particular status or placement in the state– it is one of the important subjects in the school curriculum as it is one of the subjects of Indonesia's National Examination (a prerequisite to successfully graduate from school).

Indonesia's position on English is also described as those of the "Expanding Circle" countries. Where in the Outer Circle, the proficiency of the language varies greatly, the Expanding Circle characterizes itself with the nonexistence of a local model of English. Other than having no official status, English as a language in Indonesia "has not become institutionalized with locally developed standards of use," (Kachru, 1992 in Mckay, 2002: 10).

Long ago, the most important animal (including human) sounds were those produced by predators, prey, and reproductive mates (Ladefoged, 2001).Through the development of civilizations, current conditions show that sounds and verbal symbols have become one of the most important components in a language. In the book "Principles of Language Learning and Teaching" by Brown (2007), it is said that language is a set of arbitrary symbols which are mostly vocal though visual symbols or texts do exist.

Aside from the structure of a foreign language, language learners also need to acquire the sound and pronunciation system of that language. English, in this case, clearly has a different sound system in comparison to Indonesian (This will be explicated later in the literature review section). Research about foreign language phonology acquisition supports the correlation between the age of learning and the ability to have what is widely known as a native speaker's ability. Age is such a contributive factor because neuromuscular plasticity, brain development, sociobiological state, and the environment with its sociolinguistic impact (Brown, 2007). As such, this research takes age as a variable and chooses only those who are past the 'sociobiological critical period' for speech and accent acquisition, who are counted as teenagers and above (12 years and above).

In the teaching of English in Indonesia, speech is an important aspect that needs to be investigated. Indonesian language, aside from originating from different linguistic families (Austronesian and Indo-European respectively), differs from English in terms of structure and language system. Indonesian language is what one could call a phonetic language–it has predictable patterns in which, simply said, what is pronounced usually constitutes what is written. English, has received words and sounds from many other languages, incorporating lexemes into the language (tempeh, for example, is already a part of the English vocabulary). This has made pronouncing and spelling in English less predictable. Take the following four words as examples: bough, cough, rough, and through. The 'ough' ending that the four have in common do not indicate similarity in articulating the ending of each word. In fact, they are all different–/ ba□/ (bough), /k □f/ (cough), / r□f / (rough), dan / θruː / (through). Only two of four 'gh' endings share the same sound (/f/). It would be safe to say that Indonesian learners will encounter difficulties with just seeing the disparity of the two sound systems.

Foreign language learning does not necessarily demand learners to acquire perfect phonemic and phonetic mastery of the language. Usually, effective communication is the aim with the mastery of certain authentic accents or dialects as the icing on the cake. The notion is supported by the fact that most of the English language learners in the Outer (where English is important for either historical reasons or because it has an official role in the nation) and Expanding Circle (the rest of the countries outside of the inner and outer circle) countries learn the language to communicate to locals and other language learners as opposed to native speakers of English (Saraceni & Rubdi, 2006). However, noting that most of the time the delivery of meaning is the central aim of communication, the speech produced by learners has to be intelligible for the language to be functional. Additionally, Jenkins (2000 in Mckay, 2002) stated that pronunciation lessons have to focus on areas that have the greatest influence on intelligibility, which are particular segmentals, nuclear stress, and the effective use of articulatory setting. This paper aims to investigate an aspect that has a measurable impact on Indonesian learners' speech: a particular segment.

There may be no pressure on English language learners in India, an Outer Circle country, to use British RP. Low motivation and lack of access to RP speakers are the main cause of Indian language learners to adopt their own variation of English (which is not stigmatized) to increase functionality. However, as Agnihotri (1994 through Mckay, 2002) examines, though Outer Circle countries may have the preference of using and promoting local pronunciation patterns, it may not be the same for Expanding Circle countries like Indonesia. Rather, as various researchers (Dalton–Puffer, Kaltenboeck, and Smit, 1997) have discovered, there is a powerful desire for students of English in Expanding Circle countries to attain and appreciate native–like (RP and GA) pronunciation.

The issue emerges when adult students in Indonesia learn the English sound system. Brown (2007: 73) stated:

> "Adult second language linguistic processes are more vulnerable to the effect of the first language on the second, … Whether adults learn a foreign language in a classroom or out in the 'arena,' they approach the second language–either focally or peripherally–systematically, and they attempt to formulate linguistic rules on the basis of whatever linguistic information is available to them: information from the native language, the second language, teachers, classmates, and peers."

Learners of English may experience interference from their first language, which is Indonesian in this case. The impact of first language interference is not limited to structure, but also the sound system. In accordance to the previous statement, this research focuses upon two English phonemes which are notoriously difficult to acquire even for European students of English as a second language (Wester et al. 2007). The two phonemes are /θ/ and /ð/. Those two phonemes do not exist in the consonants of Indonesian language, so the learners would have to overcome the difficulty of acquiring those sounds in one way or another. Brown (2007:138) explicates about avoidance and compensatory strategies which include compensating the use of a word that contains difficult sounds using another word, successfully acquiring the new phonemes, or substituting the phonemes with others which are perceived as similar with or without realizing it.

The pronunciation of two dental fricatives of English in numerous situations will be assessed by having students of a General English (grade 4) class in LBI FIB UI read texts or describe objects. However, this research aims to analyze and describe substitutions of that phoneme as opposed to the usual study on prevalence of errors. The writer will use Optimality Theory by Prince and Smolensky to explain the constraints involved when a speaker makes the decision (both informed/deliberate and subconsciously) to substitute the phonemes/θ/ and /ð/ with other known phonemes.

To find out the background and constraints of substitution choice, this research focuses on English speech by native Indonesian speakers who generally have the same level of English skills. By being in the same class, one chooses to dismiss several variables that may or may not have an impact on the participants which includes, for example, skill of their language teacher, condition of class, social relation between students in the class. Although the writer does take account of clear individual variables (like the participant's first language, language spoken at home, and so on) through a questionnaire. This research also discusses segmental aspects of the sound without paying heed to suprasegmental factors such as prosody. Additionally, even though sociolinguistic variables of the subjects may affect the speech, the writer has controlled the standard of subjects. The standard includes those who use Indonesian as their main language, use Indonesian as the language they use at home, has learnt English for at least 12 years, is at least 14 year–old (according to the Critical Period Hypothesis Brown, 2007), and have not lived in a country of which its national language is English. Thus, sociolinguistic variables are generally dealt with and controlled.

1.2 Research Questions

- What substitutions are made by students of English studying in a GE 4 class in LBI FIB UI when pronouncing the two phonemes /θ/ and /ð/ in numerous situations?
- What has compelled them to utilize a certain substitute as opposed to others?
- Which phoneme is the dominant substitute when pronouncing English dental fricatives?
- What are the constraints involved in the conscious/subconscious decision to replace a dental fricative with another phoneme?

1.3 Aim

Firstly, this thesis aims to map quantitatively the frequency of each possible substituting phoneme as a replacement to the dental fricatives voiced by English learners of Indonesia in reading or describing texts or pictures. Secondly, the writer attempts to explicate descriptively the reason of using a certain substitute as opposed to other phonemes by using Optimality Theory to analyze constraints within the choice.

1.4 Significance of Research

The completion of this research is expected to provide knowledge to its readers and contribute to research in the teaching of English as a foreign language in Indonesia as well as English phonetics and its use in the international context. As a long–term benefit, the thesis is also expected to have an effect on the practice of teaching English in Indonesia, in particular, the teaching of speaking and pronunciation. It is expected that teachers of speaking will be more aware of the tendency of Indonesian learners to substitute dental fricatives and therefore try to overcome this with various exercises. Additionally, it is expected to contribute to science in this field while building on previous research in the subject.

1.5 Scope of Research

In accordance with the aim and research question, the object of this research, which is the substitutions in the pronunciation of phonemes /θ/ and /ð/, is analyzed phonetically by computer or manually to produce transcribed data.

The focus of this research is the use of phonetic theories and acoustic analysis as a basis of the discussion.

Participants whose voices were recorded were students of GE 4 LBI FIB UI. They have studied English through primary education (mostly for 12 years from elementary to high school), use Indonesian as their main language (the mother tongue from different areas of Indonesia may differ, but each individual admits and assumes Indonesian as their main language), are not in their 'critical period' (teenagers and above), and are willing to participate in the research. These are characteristics which are common to all participants recorded. The English proficiency of each individual does not differ significantly because there is a rigid selection constituting a placement test prior to being placed in a particular class. The GE 4 class, in particular, needs a score of 30–40 points in the placement test to be admitted.

1.6 Data Source

Data is gathered from the recording of each GE 4 student in one class. Each participant reads texts and describes pictures which were designed to have a particular number of the two phonemes /θ/ and /ð/ represented in several positions in a word. The recording is done in a closed classroom with a Sony IC Recorder.

1.7 Thesis Organization

The thesis consists of five chapters. The first chapter is the introduction, and it includes background, research questions, aim, significance of research, scope of research, data source, and thesis organization as its subchapters. The second chapter is the review of literature on the English sound system, Indonesian sound system, markedness hypothesis, contrastive analysis, phonetic data analysis, Optimality theory, and related literature. The third chapter explains the methods used in this research. The fourth chapter presents the findings and discussion. The subchapters in the fourth chapter consist of possible substitutions, prevalence of substitution, and constraint analysis of substitution. The fifth chapter sums up the thesis with the conclusion.

CHAPTER 2
LITERATURE REVIEW

2.1 Speech Sound Production

The primary function of a language is to convey information. As such, a language can be in numerous different forms. Other than being spoken or written, it can be sent in codes or depicted in Braille for the blind. Although speech is the most common and prevalent way of using language, there are a lot of extra–linguistic information conveyed in one's speech. In essence, one's speech indicates where you come from, which socioeconomic group you originate from, and so on. It can tell us what people are feeling, or how they wish to perceive us or be perceived by us.

Speech, as (currently) the most significant aspect of language, consists mainly of the linguistic feature of voice–expressed in the sounds produced by the vocal organs. In describing these sounds, the study of phonetics has provided three different ways. The field of articulatory phonetics identifies sounds from the vocal organs used to produce them. The interaction of several different physical organs produces different sounds that are classified according to the way they are produced and the location of organs involved in speech production. . In acoustic phonetics, sound is described in sound waves that are produced whenever you speak–a disturbance in the air which is composed of a small but rapid variation in air pressure travelling through the air (Ladefoged, 2001). The third method is to symbolize each segment by using the International Phonetic Alphabet (the IPA) symbols. The symbols depict each sound with a standardized representation of almost every segment known. This paper will deal with all three ways of describing speech sounds, focusing on the first two ways and utilizing the IPA symbols to identify distinctive substitutions made by the subjects.

To start, every sound we make when speaking is the outcome of muscle contraction. Muscles in the chest area that are used for breathing produces airflow. The air reaches the vocal tract travelling to the nostrils and mouth. Humans possess a number of muscles that can alter the shape of the vocal tract according to the sound individuals wish to produce. Thus, it is a necessity for people to acquire familiarity with different parts of the vocal tract–experimenting and retaining different sounds produced by different alterations made in the vocal tract (Roach, 1998). The picture below depicts the vocal tract showing the location of places of articulation and vocal organs. Each part–combined or individually– has a role in modifying the airflow emitted from the lungs to form what is defined as speech in a language. Future references to articulation processes are made based on the diagram below.

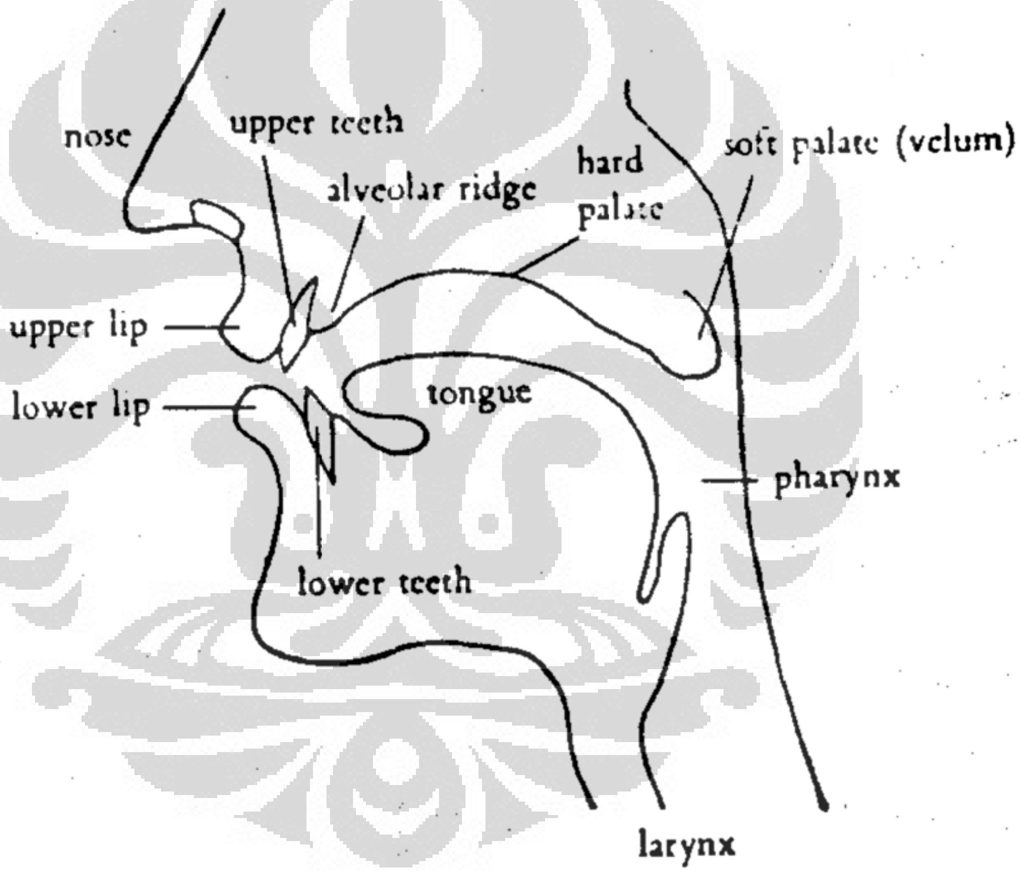


Figure 2.1: Articulators and Places of articulation (taken from Roach, 1998: 12)

Some places of articulation that include movement of the tongue or lips are (Ladefoged, 2001:99):

1. Bilabial: the upper and lower lip closes
2. Labiodental: the lower lip near the upper lip

3. Dental: the tip of the tongue's positions near the upper front teeth
4. Alveolar: the tip or the blade of the tongue in contact with or near the alveolar ridge.
5. Post–alveolar: the blade of the tongue near the front part of the hard palate directly behind the alveolar ridge.
6. Palatal: the tip of the tongue near the hard palate.
7. Velar: the back of the tongue in contact with the velum (soft palate).
8. Labiovelar: the two lips near each other while the back of the tongue is raised towards the velum

There are some other places of articulation like glottal, but since the focus of this research is on phonemes which are produced by motions and positions of tongue, teeth, lips, and other passive articulators, only the places of articulation described above will be used as reference.

Aside from the places involved when a person emits a sound, there are also different 'manners' in which each vocal organ operates. General manners of articulation include (Roach, 1998):

1. Stop/plosive: complete closure of the vocal tract. Air is blocked from going out through the nose and the mouth.
2. Nasal: Closure of the vocal tract such that air can go out through the nose, but not the mouth.
3. Fricative: Constriction of the vocal tract so that a noisy airstream is formed.
4. Affricate: A stop followed by a fricative made at the same place of articulation.
5. Approximant: Constriction of the vocal tract to a smaller extent than that required for a noisy airstream.
6. Lateral: The tongue touching the roof of the mouth but without contacting the teeth at the sides.

Ladefoged (2001:101) describes manners of articulation vividly by comparing it to a garden hose:

> "The airstream is like water flowing through a garden hose. You can squeeze the hose at many different points and alter the flow of water. If you squeeze it tightly so that no water can flow, it will be like a stop. Producing a nasal would be like attaching a side tube to the stopped hose. Squeezing the hose so that only a small jet of water comes through corresponds to a fricative. A more gentle squeeze allowing water to flow fairly freely corresponds to an approximant. If you can manage to press the middle of the tube and allow water to escape around the sides, that will correspond to a lateral."

There are, of course, other manners of articulation such as the flap/tap, which exists in American and Australian English, the trill in Spanish, and lateral fricatives in Welsh and Zulu. However, since the textbook used in the teaching of the subject in the participant's class (GE 4) corresponds to the accent of British English, particularly that of the Received Pronunciation, the references will be made to the manners of articulation above (by Ladefoged).

In this context, consonants experience a range of different manners and places of articulation and thus produce a range of different sounds. To sum up, articulatory phonetics with its manners and places of articulation is one way of describing sounds by giving details on how a sound is produced.

2.2 Indonesian Sound System

The Indonesian sound system needs to be explained in great detail since this research involves 'native' Indonesian speakers and their pronunciation of English. As mentioned previously, the description of sounds may rely on the phonological representation. In the practice of describing Indonesian speech sounds, the notion of underlying form of a morpheme that has been associated with abstractness is coined as the 'underlying' form that represents segments

In this subchapter, the writer will mostly be using Hans Lapoliwa's comprehensive account of the Indonesian language's phonology. It is compiled in a book called "A Generative Approach to the Phonology of Bahasa Indonesia". The text deals with issues related to loanwords, variations, and debates on the subject that are still relevant until today. Thus, despite the time of its publication (1981), it can still be accepted as a reliable guide towards elucidating Indonesian phonology at work. The description will be limited to consonant sounds, but it is worthy to note that there are six vowel phonemes in Bahasa Indonesia (Alisjahbana, 1951, Halim 1974, Johns 1975, Kahler 1956 in Lapoliwa, 1981:28) which are /i, e, ə, a, u/ and /o/.

Generally, Indonesian consonant sounds are represented by these International Phonetic Association symbols: [p, b, t, d, k, g, □, f, s, z, ç, x, h, t□□, d□□, m, n, □, ŋ, l, r, w]. Many works of Indonesian phonology acknowledge the usage of 23 consonants (Lapoliwa, 1981). However, some have refuted this in the consideration that the glottal stop [□] is more of an allophone of the velar stop /k/ which has, by definition, a classifiable function in its complementary usage. It was observed that the glottal stop [□] only occurs in the final position in a word while [k], the other allophone of the phoneme /k/, is used in word-initial and word-medial positions. Even though the complementary relationship between the glottal and velar stop [□] and [k] is virtually rigid, there are exceptions such as *saat* [sa□at] (moment, time) and *soun* [so□un] (rice noodle). So, for this research, the 23 consonants including the glottal one as prescribed by Lapoliwa will be acknowledged.

The 23 consonants of the Indonesian language can be described further by allocating each one to the characterization of manner and place of articulation as follows:

Manner of Articulation		Place of Articulation				
		Labial	Dental/Alveolar	(Alveo–) Palatal	Velar	Glottal
Plosives	Voiceless	p	t		k	□
	Voiced	b	d		g	
Fricatives	Voiceless	f*	s*	ç	x*	h
	Voiced		z*			
Affricates	Voiceless			t□□		

	Voiced			d□□		
Nasals		m	n	□	ŋ	
Laterals			l			
Trills			r			
Approximants		w		y		

Table 2.1 Indonesian consonant sound table (Adapted from Lapoliwa, 1981:12)

As indicated in the table, the phonemes with an asterisk (*) show that they originate from loanwords and do not generally occur in Indonesian as a Malay language. Brief descriptions of consonants that are not directly related to the substitution process are shown below:

/p/ is produced using the labials as articulators without vocal fold vibration. Examples: *apa* /apa/ *padi* /padi/

/b/ is produced using the labials as articulators with vocal fold vibration. Examples: *bilang* /bilaŋ/ *ibu* /ibu/

/k/ is produced using the velum and tongue as articulators without vocal fold vibration. Examples: *katak* /kata□/ *kuku* /kuku/

/g/ is produced using the velum and tongue as articulators with vocal fold vibration. Examples: *raga* /raga/ *giat* /giat/

/□/ is produced using the glottis as articulator. Examples: *arak* /ara□/ *bapak* /bapa□/

/ç/ is produced using the palate as articulator without vocal fold vibration. Examples: *asyik* /açi□/ *masyhur* /maçhor/ (free variation)

/x/ is produced using the tongue and uvula as articulators without vocal fold vibration. Examples: *kabar* /xabar/ *ikhlas* /ixlas/ (free variation)

/h/ is produced using the glottis as articulator with or without vocal fold vibration (voiced in intervocalic positions). Examples: *hari* /hari/ *buah* /buah/

/t□□/ is produced using the alveolo–palatal ridge as articulator without vocal fold vibration. Examples: *cinta* /t□□inta/ *baca* /bat□□a/

/d□□/ is produced using the alveolo–palatal ridge as articulator with vocal fold vibration. Examples: *jari*/d□□ari/ *puja* /pud□□a/

/m/ is produced using the lips and nasal tract as articulators with vocal fold vibration. Examples: *masa* /masa/ *hama* /hama/

/n/ is produced using the lips and nasal tract as articulators without vocal fold vibration. Examples: *akan* /akan/ *nama* /nama/

/□/ is produced using alveo–palatal ridge and nasal tract as articulators with vocal fold vibration. Examples: *nyeri* /□eri/ *anyam* /a□am/

/ŋ/ is produced using alveo–palatal ridge and nasal tract as articulators without vocal fold vibration. Examples: *tangan* /taŋan/ *tolong* /toloŋ/

/l/ is produced using the alveolar ridge as articulator with vocal fold vibration. Examples: *lalu* /lalu/ *tali* /tali/

/r/ (trill) is produced using the alveolar ridge as articulator with vocal fold vibration. Examples: *marah* /marah/ *sarang* /saraŋ/

/w/ is produced using the labials and velum as articulators with vocal fold vibration. Examples: *bawang* /bawaŋ/ *rawa* /rawa/

/y/ is produced using the palate ridge as articulator with vocal fold vibration. Examples: *rantai* /rantay/ *bayang* /bayaŋ/

The Indonesian consonants included as the focus of this research are /t, d, f, s/, and /z/. The phonemes represent possible substitutions of the tested speech sounds /θ/ and /ð/. Besides previous recent studies which have shown facts supporting these possible substitutions (Wester, et al. 2007, Tiono, 2008), /f/ is phonetically similar to /θ/ and /ð/ while /s/ and /z/ have similarities from a phonological point of view. The Equivalence Classification notion is defined as "…a basic cognitive mechanism which permits humans to perceive constant categories in the face of the inherent sensory variability found in the many physical exemplars which may instantiate a category." (Flege, 1987: 49) The Equivalence Classification theory attempts to explain why learners of a second language often fail to authentically produce foreign speech sounds. Drawing from the Equivalence Classification, the phonemes /f, s/, and /z/ are possible substitutions for dental fricatives of English because native Indonesian speakers may classify the dental fricatives as sounds which do not differ from their previously learnt sounds–grouped for their 'equivalence'. /t/ and /d/, which are the least segmentally marked and widely occurring phonemes, are also possible substitutions as the dental fricatives are segmentally and universally marked (F. Wester et al. 2007), meaning that /θ/ and /ð/ are more difficult to acquire and speakers are less inclined to utilize them compared to other consonant sounds. To explicate the possible substitutions comprised of five consonants, a more detailed description is provided below:

The phoneme /f/, which was originally a "loan consonant" (Lapoliwa, 1981: 26), has minimal pairs existing in Indonesian language. Examples derived from English include *fakta* /fakta/ *pakta* /pakta/ (fact and pact respectively). Their place of articulation is labiodental while their manner of articulation is fricative. It is a voiceless counterpart of the phoneme /v/. The morphemic representation of [*v*] in Indonesian is read as /f/ as well. Most Indonesians (though the Sundanese often confuse it with /p/) are well acquainted with this speech sound and use it in everyday speech. In previous researches, the phoneme /f/ is notorious for interfering with the English sound system (Tiono, 2008) in particular with dental fricatives and /v/.

The phonemes /t/ and /d/ are considered the least marked speech sounds since their manner of articulation is plosives with dental place of articulation.

The sonority hierarchy (Lacy, 2006: 68) of markedness shows, in order of the least marked to the most marked:

Voiceless stops > voiced stop > voiceless fricatives > voiced fricatives > nasals > liquids >glides > glottal

The sonority hierarchy is one of the ways one can distinguish segments by their markedness. /t/ as a voiceless stop and /d/ as a voiced stop are rated as the least marked in comparison to the other possible substitutions /s/, /z/, and /f/ which are fricatives in terms of manner of articulation. /t/ is an unaspirated apico–dental sound without vocal fold vibration while /d/ is an apico–dental sound with vocal fold vibration. Both phonemes may be retroflexed in certain dialects though this is never considered standard (Lapoliwa, 1981).

While the sound /f/ may be easily mistaken for /θ/ due to similar acoustic characteristics at the spectrum level–flat below 10kHz (Wester et al. 2007), /s/ is easily distinguishable with "a relatively sharp low frequency cut off" (Ladefoged and Maddieson, 1996 in Wester et al. 2007: 481) and spectral zero's. However, the phonemes /s/ and /z/ can be viable substitutes because they are phonologically similar to the dental fricatives. The only phonological feature that distinguishes the /s/ and /z/ from /θ/ and /ð/ is the [strident]. Often called sibilance, the phonemes are louder than their non-sibilant counterparts, and their energy occurs at higher frequency.

Though not originally a sound of the Indonesian language, /v/ is worthy of note since unlike in Indonesian, English distinguishes the sounds /f/ and /v/. The Indonesian language does not distinguish between the two phonemes and use /f/ for both instead. To illustrate, the /v/ in *universitas* and the /f/ in *kafan* are pronounced the same (i.e. as /f/). This is why hypothetically, one should find /f/ used more often as a substitute compared to /v/. /v/ may be used to substitute the voiced dental fricative /ð/ due to its similar vocal fold vibration.

To conclude, the descriptions of the Indonesian sound system–in particular the consonants– are an important section of this research because the investigation focuses solely on the predicted substitutions the subjects would make upon encountering the marked dental fricatives of English. Possible substitutions are /t, d, f, s/, and /z/. They are predicted to substitute for /θ/ and /ð/ due to their similar nature. /t/ and /d/ are the least marked and most commonly occurring phonemes, occurring in 99.7% of UPSID (UCLA Phonological Segment Inventory Database) languages (Wester et al. 2007). /f/ is also a possible contender substitution as it is the most phonetically similar to the dental fricatives. At one point, the identification of /f/ is often mistaken for /θ/ and vice versa. Tabain (1998 in Wester et al.) concluded from his experiment that native speakers perceive /θ/ as /f/ in 29% of the cases while they perceive /f/ as /θ/ in 28% of it. However, this experiment discusses how listeners perceive certain segments. When attempts to examine the pronunciation of a certain group of speakers learning English is done, the results will obviously differ since production and perception are two (though interconnected) different cognitive processes.

2.3 English Sound System

"*That which we call a rose*
By any other name would smell as sweet," William Shakespeare, Romeo and Juliet, Act II, sc. Ii

Segments that build up a word are symbolic. Whether written or spoken, there is no necessary connection between the shape of a word and its meaning. When one attempts to associate between sounds of words to the meaning, it requires connections to other areas. Thus, although the words alone do not really "matter" (yes, a rose would still smell sweet if it was designated with another name), the meanings associated with them do. In the perception of sounds produced by other people, segments are identified individually (through minimal pairing) and as a whole in words, sentences, or even paragraphs to recognize its meaning. The correct usage of the lowest level of sound, the segment, is vital to the understanding of others in terms of making communication effective.

A descriptive account of the English sound system will be made mostly using two references which are Ladefoged's *Vowel and Consonants: An Introduction to the Sounds of Languages* (2001) and Roach's *English Phonetics and Phonology: A Practical Course* (1998). Both are accounts to English phonetics and phonology though Ladefoged is more inclined to practical accounts of creation of sounds and acoustics of English while Peter Roach provides a very comprehensive and in–depth account of the topic.

The form chosen as a comparison for the tested subjects is the BrE, specifically the Received Pronunciation. The reason for this is that the modules taught in class use the British variation of English. The recordings in listening exercises also display numerous British accents, with several regional variations of English. However, there are only minor differences in the consonants of the principal dialects of English so it is unnecessary to discuss British and American English separately (Ladefoged, 2001).

Generally, English consonant sounds are represented by these International Phonetic Association (henceforth referred to as IPA) symbols: [p, b, t, d, k, g, f, v, θ, ð, □, □, □, □, s, z, x, h, m, n, ŋ, l, r, w, j].

The 24 consonants of English language can be described further by allocating each one to the characterization of manner and place of articulation as follows:

Manner of Articulation		Place of Articulation							
		Bilabial	Labiodental	Dental	Alveolar	Palato–alveolar	Palatal	Velar	Glottal
Plosives	Voiceless	p			t			k	
	Voiced	b			d			g	
Fricatives	Voiceless		f	θ	s	□			h
	Voiced		v	ð	z	□			
Affricates	Voiceless					□			
	Voiced					□			
Nasals		m			n			ŋ	
Laterals					l				
Approximants		w				r	j		

Table 2.2 English Consonant Sound Table (Adapted from Roach, 1998: 62)

Out of the many consonant sounds, some are attributed to the beginning or ending of vowels. Such is particularly correct for stops such as /p/, /b/, /t/, /d/, /k/, and /g/. These sounds are called stops because the airflow going through the vocal tract is completely stopped at some point. Each of these stop consonants form a rapidly changing sound. In the previous subchapter, a brief description of these consonants at work is provided. Since two of six consonants are viable substitutes of the dental fricatives and its usage may also be attributed to the acquisition of English consonants, a more rigorous description of the English stops in particular are given.

The glottal plosive occurs frequently but is of less importance since it is usually only a free variable of /p/, /t/, or /k/ in many situations (Roach, 1998). All six plosives can occur at the beginning of a word (initial), between sounds (medial), and at the end of segments or words (final). When the stops produced are in a hold phase, in the initial positions, there is no voicing in /p, t, k/ and normally extremely little voicing in /b, d, g/. The release phase of /p, t, k/ is then followed by an audible plosion sound (a burst of noise, hence named plosive). Aspiration is then produced prior to the voicing process making a sound similar to /h/. The release of /b, d, g/, however, is followed by a weaker burst of noise and happens concurrently or shortly after the voicing. These different phases definitely happen very rapidly, but the ear can easily distinguish between the plosives (Roach, 1998).

On the other hand, the fricatives of English require a more complex understanding. Similar to the plosives, with the exception of the glottal sound, each place of articulation has a pair of phonemes, one voiced and one voiceless.

The dental fricatives, in particular, may actually be difficult to perceive using one's own ears. The spectrogram of /f/ has greater intensity between 3,000 and 4,000 Hz while the voiceless dental fricative /θ/ shows energy over ranges of higher frequency with its center of above 8,000 Hz. Though the dental fricatives have been described as the tongue was actually placed between the teeth, as in interdental fricative (which may be true for speakers of General American), the tongue is actually placed inside the teeth with the blade touching the inside of the upper teeth. Through this, the airflow goes between the gaps of the tongue and teeth with a weak fricative noise (similar to those in /f/ and /v/).

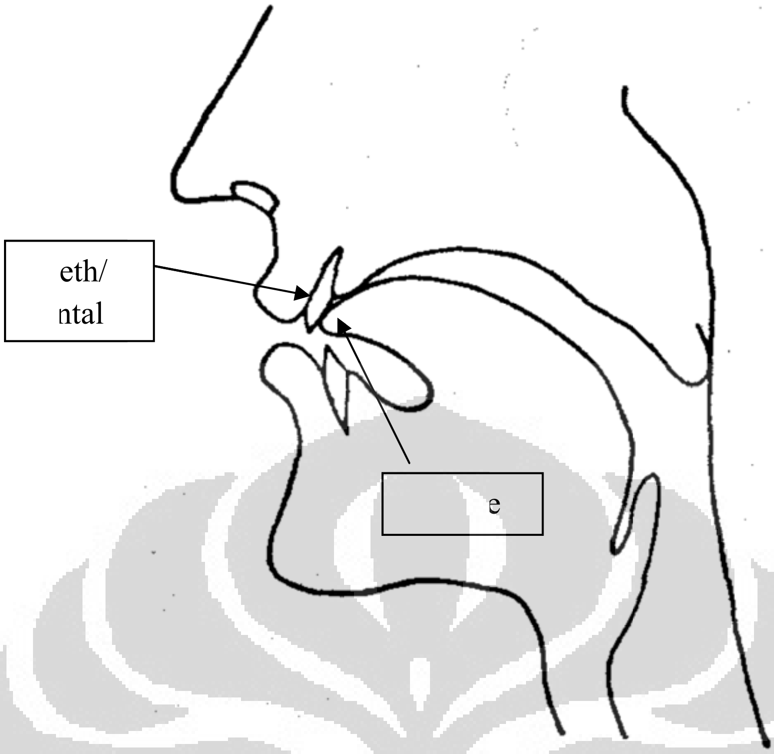


Figure 2.2 Articulators in position for Dental Fricative (taken from Roach, 1998: 6)

The dental fricatives of English are oral consonants, allowing airflow to escape only through the oral tract. They are also categorized as a central consonant, where air is directed to the centre of the tongue as opposed to the sides. The mechanism is pulmonic, as in the flow of the air is directed by the means of lungs and diaphragm. The voiced dental fricatives /ð/ "has formants produced by pulses from the vocal folds as well as more random energy produced by forcing air through a narrow gap." (Ladefoged, 2001: 58). This distinguishes it from the corresponding voiceless fricatives /f/ and /θ/ with the vocal folds in lesser vibration while forcing air through the glottis. The phonetic symbol for 'th' as in *thigh* is /θ/. It is also important to note that the symbol for 'th' as in *thy* is /ð/, which is a modified version of the old Anglo–Saxon letter for this sound. They are the only pair of phonemes that are represented by one grapheme, which is the <th> digraph. Smith (2007) describes the dental fricatives of English as follows:

> "The dental fricative is the only sound produced at this place of articulation, regularly ranging from between the teeth (interdental) to just infront of the alveolar ridge (post–dental), and is free to vary in manner without impinging on the boundaries of any other phoneme because it is unique in its place of articulation. Sometimes, however, it does overstep phonemic boundaries, resulting in well–known substitutions such as the alveolar stops or labio–dental fricatives that occur in some sociolects and dialects,"

To close, the voiced and voiceless consonants of English are divided into the manner in which they are articulated as in: stops/plosives, approximants, nasals, fricatives, and affricates (different from the Indonesian counterpart, which has no trill). The sudden beginning or ending of vowels next to it can identify the spectrograms of plosives easily. The voiceless fricatives have varying bursts of energy over wide ranges of frequencies (mostly high). Their voiced counterparts have similar energy distribution with the addition of formant resonance. Dental fricatives of English are oral central pulmonic consonant sounds, with different ranges of articulation place and is produced generally by placing the tongue 'inside' of the teeth. This research uses BrE and RP to classify the English sounds though it was previously stated that the primary variants of English do not pose significant differences to its consonants.

2.4 Contrastive Analysis

Contrastive analysis is a method that is used by applied linguists to analyze linguistic aspects of two or more languages. In general, the use of contrastive analysis is based upon the principle of linguistic transfer. Linguists predict and analyze language issues or problems based on the transfer of one language to another and then explain methods on dealing with the issue.

Concurrently, there are linguists who feel the prediction is not actually needed and may be impossible to do. As a result of the debate, there were two models of contrastive analysis have emerged (Eppert, 1983). The first model is ECA or Explanatory Contrastive Analysis and the second one is PCA or Predictive Contrastive Analysis. ECA uses the result of a contrastive analysis to explain numerous cases of transfer after a case is observed and recorded. PCA took the contrastive analysis a step further by using methods that attempt to predict potential transfers of aspects of the first language to the second language (which is being acquired).

Both methods have their own criticism. PCA's competence to predict transfers of certain linguistic aspects of a language and describe it is doubted in the midst of other, more descriptive linguistic models. There are also those who attack the potency of PCA itself as a means to really 'predict' second language errors. Whether these criticisms are true or not are still a debate between the supporters of ECA and PCA. Conversely, ECA was criticized for not utilizing the maximum potential of contrastive analysis. The supporters of PCA see ECA as (metaphorically) "treatment after death" or "a posteriori diagnostic". This notion of ECA as a meaningless treatment after the error has already occurred is because ECA only focuses on errors which occur in the society. This has both advantages and disadvantages of a model– ECA is more empirical while PCA has the potential to deliver a greater impact to the progress of studies.

This research utilizes both ECA and PCA. ECA is used because in proving a hypothesis that directs to a certain generalization, empirical data can be used to support the argument. In this context, the research uses Indonesian phonology data (which is already well established) and English phonology to contrast them together. This forms a basis where PCA can be utilized to predict the possible substitutions (which turned out to be the five phonemes /t, d, f, s/, and /z/).

2.5 Phonetic Data Analysis

In describing how certain groups of people talk, one has to gather the data necessary for a mapping and analysis of the speech. Such is true whether one is trying to identify how a group of people pronounce several segments of speech from another language (as in the case of this research) or when you want to investigate the sound system of a language that is close to extinction. To summarize the stages of phonetic data analysis, in particular, of consonants, the process is divided into nine stages. First, form the hypothesis through a pilot study (an experiment or literature review), afterwards one has to decide what to record, then find the speakers, find a recording system, make the recording, make notes on the spot, listen to the recordings while transcribing, inter–rating the transcription using the computer, and write the phonetic data analysis. The process is mainly taken from Ladefoged's *Phonetic Data Analysis* (2003). However, I have added a few steps such as forming the hypothesis, transcribing, inter–rating the transcription, as well as writing the analysis to suit the context of the research.

Forming the hypothesis for this research involved both a pilot study on learner's errors and a literature review. The pilot study reviewed the existence of Equivalence Classification (by Flege) by investigating the pattern of errors Indonesian learners of English make. Other than the 'global errors' that emerge as a result of normal learning progress, there were several patterns which were discussed by other authors (for example, Tiono, 2008) as well. For one, the difference of phonemes related to language sound system does not always yield to frequent errors. The pilot study found that even though the Indonesian language does not originally have the consonant sound of 'ch' /□/, the learners have few problems in pronouncing those sounds in English. However, other sounds such as /v/ or the dental fricatives of English encounter dire problems that are dealt with promptly by the learners by substituting them with a similar phoneme taken from the Indonesian language. The review of related literature also supports the pilot study's findings– studies from Indonesia and other countries has proven the notoriousness of the acquisition of phonemes that are 'Equivalent' to another in the learner's first language. An exemplary phoneme that has high prevalence of such phenomenon is the dental fricatives of English in subject.

Regarding the decision on what to record for a phonetic data analysis, Ladefoged (2003: 9) stated:

> "The principal data will be word lists for the phonemic constrasts and specific sentences for describing the basic intonational patterns… From a phonetician's point of view there is no point in making lengthy recordings of folk tales, or songs that people want to sing. Such recordings can seldom be used for an analysis of the major phonetic characteristics of a language, except in a qualitative way. You need sounds that

> have all been produced in the same way so that their features can be compared."

This research has done just that with the addition of using pictures to elicit certain sounds. The explanation for this section will be described in greater detail in the next chapter (in Procedure).

2.6 Optimality Theory

The basis of this research and its development on research related to the subject is the usage of optimality theory. Optimality theory, which was originally pioneered by Prince and Smolensky (Science, 1997), was derived from a principle of neural computation–optimization. The perspective of optimality on grammar and phonological acquisition has been given a positive review. Many publications have been made using the framework of optimization.

Optimality theory is based upon the assumption that grammars have constraints on well–formedness of linguistic structures. Such constraints are constantly challenging each other and in conflict. The examples provided by Prince and Smolensky (1997) was on the basic word order of English. While the basic word constraint entails and supports subject–verb–object (rather prohibiting other orders to occur), in a sentence like *what did you see?* the object stands first. The constraint of question words appearing in the front of a question sentence that is suggested by *what did you see?* is not absolute, as questions such as *who saw what?* do exist with their own set of constraints. These constraints do have values that increase or decrease according to context, though some are universal. Constraints are very much language–specific and are shaped by both their usage and the original form or grammar of the language.

To relate it to the research, similar conflicts of constraints in the process of phonological acquisition also exist. An example is the ending of the past form of the verb *stop*, *stopped* is pronounced as /stopt'/ instead of /stopd/ because the constraint regarding the usage of the phoneme /d/ after the consonant /p/ as a voiced plosive conflicts against the hierarchy of constraints. This phonological constraint clashed with the constraint of tense markers using –d. Its prevail marked a key observation that is central to this theorem: it is clear that the markedness constraint dominated the faithfulness constraint of following the original input of –d. Thus, as Prince and Smolensky (1997:1605) stated,

> "…no amount of success on the weaker constraint can compensate for failure on the stronger one. Put another way: Any degree of failure on the weaker constraint is tolerated, so long as it contributes to success on the stronger constraint. Extending this observation leads to the hypothesis that a grammar consists entirely of constraints arranged in a strict domination hierarchy, in which each constraint is strictly more important than—takes absolute priority over—all the constraints lower–ranked in the hierarchy. With this type of constraint interaction, it is only the ranking of constraints in the hierarchy that matters for the determination of optimality; no particular numerical strengths, for example, are necessary."

Inside the set of universal constraints, several subcategories of constraints have been established. The two major constraints that will be used throughout the analysis of this research are markedness and faithfulness. Markedness refers to when an aspect of linguistic structure is more complex than an alternative– the dimensions relevant to markedness may correlate with production, comprehension, memory, or related physical and cognitive functions (Prince & Smolensky, 1997). These marked linguistic elements of a language may have restricted or limited usage in some languages or are non–existent in others. Markedness has a long history in the field of phonological theory, but a significant question that one still ponders about is which linguistic processes are sensitive to markedness and which ones are not? (Lacy, 2006) The analysis of pronunciation of words and sentences containing dental fricatives will involve a lot of interaction with the markedness as a constraint and phenomenon as substitutions of the marked sounds with unmarked ones will occur when preservation of those universally marked fricatives is not seen as necessary.

Faithfulness, on the other hand, may often be on the other side of the conflict against markedness. Faithfulness constraints would encourage and make sure that the input resembles the output– representation in the input should be exactly represented in the output.

There is also a specific manner in describing certain constraints in conflict within a linguistic phenomenon. To explicate, below is a constraint tableau depicting the segment choice and computation of optimality in graphic form (Wester, et al. 2007:487):

think /θɪŋk/ realised as [sɪŋk] (only the relevant constraints are depicted)

/θɪŋk/	Correspondence [continuant]	Segmental markedness
[θ]		**!
☞ [s]		*
[t]	*!	
[f]		**!
[ð]		**!*
[z]		**!
[d]	*!	*
[v]		**!*

Table 2.3 Optimal computation of *think* by Dutch speakers (Wester, et al. 2007:487)

In the table above, the input is at the top left side of the table on top of the first column (*think)*, and the selected candidates of the output are listed below it. Constraints are listed in the order of strength from left to right on the first row (Correspondence [continuant]>>Segmental Markedness). The rows below it show the constraint evaluation of output candidates through the constraint hierarchy. The hand indicates the optimal candidate [s]. The asterisk (*) shows a violation of constraint. An exclamation mark shows a fatal violation of the constraint by the candidate. [t] and [d] violate the constraint Correspondence [continuant] fatally because it does not adhere to the phonological rule of being a continuant (like other candidates) and are instead categorized as plosives. [t] does not violate the constraint of segmental markedness because it is the least marked phoneme–adhering to all the default features of a consonant which are listed in a table as follows:

Place	Laryngeal	Manner
[+coronal] [+anterior]	[−voice] [−spread glottis] [−constricted glottis]	[−nasal] [−continuant] [−lateral] [−rhotic] [+strident]

Table 2.4 Default consonant feature values (Wester et al., 2007: 486)

Additionally, [f] and the original input [θ] failed as output candidates due to fatal violation of the segmental markedness constraint for being [–coronal] and [–strident] respectively. [–continuant] in segmental markedness constraint is violated by all but [t] and [d]. However, [s] is the optimal output because it does not violate (at all) the dominant constraint which is Correspondence [continuant] while violating the non–dominant constraint only once due to its position as a continuant consonant. It is important to note that no level of success in a weaker constraint can compensate a fatal failure on the dominant constraint (which is placed directly on the right of the candidates' column). Thus, the most optimal output of Dutch speakers for /θIŋk/ in this study is /siŋk/.

The table is used to aid the writer in explaining the conflict of constraints happening in the investigation. Though some values of the constraint hierarchy are quantified, the explication of utilization of Optimality Theory for this research remains qualitative for exploratory purposes.

2.7 Related Studies

There are a number of studies which are related–from subjects to methods. Three which are most recently published will be addressed.

One study by Tiono and Yostanto (2008:79–112) titled *A Study of English Phonological Errors Produced by English Department Students* attempted to explain the errors produced by Indonesian learners of English from a phonological point of view. They recorded the reading of texts containing [v], [θ], [ð], [□], [d□], and [tʃ]– consonantal sounds that do not exist in the Indonesian language. Though the core idea of having newly acquired sounds (including the two dental fricatives investigated here) tested and analysed might be similar to this research, the method and theories used in the analysis section are very different. Other than not paying heed to constraints and using Optimality Theory to analyse the choices of ‘errors’, the major difference is that their research uses only the writer’s perception in its transcription as opposed to inter–rating the validity of transcription with other tools or individuals (in the case of this paper, PRAAT as the inter-rater). Aside from that, Tiono focused on the phonological perspective in the analysis section, using the theory of phonological environment (the category of vowel vs consonant and their adjacency to the phoneme tested).

Another study concerning error analysis is Parlindungan Pardede’s *The Production of English Fricatives by the Freshmen of the English Department of FKIP–UKI Jakarta: An Error Analysis* (2007). Similar to the previous study, Pardede’s inquiry focuses on the description of errors made by Indonesian students of the English department. This time, however, the main discussion is about the rate of errors in pronunciation of each English fricative tested–not only the ones that do not exist in the Indonesian language. Pardede also manually transcribed the results of the study without mentioning inter–raters or checking the validity of the phonetic transcription. Both studies are the more recent and related studies in the field of pronunciation errors (more specifically of English consonants) of Indonesian learners of English. Both are descriptive and largely quantitative in their description of the phenomenon.

The third study worthy of note would be the model from which this research is derived. The paper, which was published in *Language Sciences* (vol.29) journal, investigates the nature of substitutions in errors. Though related, the research done by Wester et.al (2007: 477–491) is highly contextual to Dutch speakers and its language system. Wester also used Optimality Theory to describe the phenomenon. In the case of the Dutch students of English, Wester discovered that many Dutch speakers retained the manner of articulation and vocal fold condition in substitutions, but with a changed place of articulation. Wester’s research is thorough but does not provide the words or sentences tested, thus making it difficult to know the context in which his subjects were recorded. The three papers as well as the pilot study gave me an insight on what to strive for in this study. Although the results may be highly dissimilar, this research attempts to build on, develop, and improve the knowledge provided by those related research.

2.8 Conclusion of Literature Review

The literature review was written based on three topics that will be discussed in this research. The first one is the language comparison aspect of this research that consists of Indonesian and English language. A thorough and exhaustive description of each sound system is a necessity because the study's thesis is based on a relationship between the two systems. The subchapter that discusses Indonesian phonetics offers the possible substitutions available upon failing to pronounce the dental fricatives of English.

The topic of contrastive analysis and phonetic data analysis is used throughout the research as it is essential. Contrastive analysis assumes the fact that language interference may happen and the first language is to be accounted for when analysing learner's errors in phonological acquisition. The principles of phonetic data analysis are also vital to the analysis of this research. Many of the phonetic analysis standards, including procedures in data collection, analysis, and data validity have to be fulfilled to accomplish a satisfactory data analysis. The guideline is taken from Ladefoged's *Phonetic Data Analysis* book.

Thirdly, Optimality Theory is the main tool used to analyse the data recorded for this research. It gives a new perspective of how phonetic samples can be investigated. The subjects of this research may have similarities with other studies, but the Optimality Theory creates new possibilities in looking at the conflict of constraints which are involved in the production of sound segments. Finally, the recently published literature is of great relevance to this research adds knowledge and is cited several times in an attempt to make a comprehensive account of and an analysis on the substitutions of dental fricatives by Indonesian learners of English.

CHAPTER 3
METHODOLOGY

To study the output of Indonesian learners of English in using dental fricatives, an experiment was conducted to record the speech produced by the subjects in three different tests to ensure validity.

3.1 Participants

Fifteen (15) students of one General English 4 class were tested. The subjects all claim Indonesian as their native language and have studied English for at least the compulsory period of time (ranging from 6–12 years) at school. They have not been to an English speaking country, and even though for some, local dialects are their mother tongue, each has stated that Indonesian is used both at home and as their main language. This is an important aspect of this research since the analysis is made on the basis that the speakers are native speakers of the Indonesian language. Additionally, it is also sensible to assume that the fact that some subjects are competent in a local dialect strengthens the generalization potential of this research–since in reality, there are many (if not most) people in Indonesia using local dialects. They have had a 'normal' exposure to English, have never lived in an English speaking country and do not use English on a regular basis aside from their school or university and 4–hour Saturday classes they are enrolled in. The age range is from 13–40, with the average of 23.3. All of the subjects have expressed voluntary consent to participate in this study. It is also worthy of note that to get into the GE 4 class, one needs to score within a range specific range (30-40 score) or pass the GE 3 class, both of which are supposedly standardized. The point here is not about measuring the subjects competence, but about the equivalence of their abilities.

The choice of participants is an attempt to gather heterogeneous subjects as opposed to homogeneous ones. Taking samples from the English Department students of my faculty, for example, would yield results that are not fit to be generalized in the wider society. Since the population is not comprised of (for example) only highly educated individuals who have had intensive training in

English– such data would not be representative at all. The 15 participants involved in the study have varying ages and occupations– from housewives, high–school students, and those of the lower socio–economic strata to professionals, teachers, and lecturers. The data about their occupation is not taken as an independent variable since the measure of their English competence is from the class they are in. Additionally, varying English exposure through their occupation represents a greater Indonesian population rather than just having subjects with the same occupation. The occupational data are collected out orally and informally. This is the marked difference that the research has in comparison to other research on the topic which uses students of the English Department. The number of participants is 15 students because of reasons related to firstly class standards –taking subjects from another class would make another variable or deviation due to differences in instruction in the classroom. Then the second reason is practicality because it was very difficult to get the subjects together and line up outside to wait for their turn to be tested voluntarily, since they are from different parts of the city and have different timetables. The third reason is related to the second– to get the best sound clarity without background noise, the meeting and data gathering has to be planned carefully (rain, for example, would ruin the recording), so the data was gathered in one meeting and there were a total of fifteen people. The questionnaire used to gather participant data is attached in the appendix.

3.2 Materials

There are 15 samples of sound recording, one from each participant. The recording amounts to about 15 minutes (one minute for each subject). The experiment involves three tests, the first one uses pictures printed on an A4 paper to elicit responses that were previously designed, containing dental fricatives. The second one uses two sentences printed on an A4 paper. The third one is a word list printed on an A4 paper. The second and third tests involve the participant reading from the pieces of paper. Though consent had been given, none of the subjects realized what they were being tested for until the end of the test. The recordings were made by using a Sony IC–Recorder type ICD–PX 820 inside a room with the subject and the researcher. The classroom used is class 4202 in building IV of the Faculty of Humanities, University of Indonesia.

The usage of three tests is based on an informed decision. The decision originates from reading several of Ladefoged's books (namely, Phonetics Data Analysis & Vowels and Consonants), Wester's journal article, and the bibliography list as a whole. To account for the 'normal' usage of dental fricatives while avoiding hypercorrection, it was a necessity to incorporate both pictures and words. All three tests have advantages and weaknesses. The picture test may not induce hypercorrection by subjects, but the data is of lower quality and poses difficulties in analyzing due to the connected speech and pauses the subjects make. On the contrary, the word list gives a very clear pronunciation of every segment without random pauses to disrupt the recording. However, such an obvious list of words containing 'th' will certainly provoke subjects to make extra effort on the pronunciation of those segments. The sentence test is in between the two tests, having connected speech while not truly encouraging hypercorrection. The average of the three tests would procure an arguably accurate account of dental fricative substitution by Indonesian learners of English

3.3 Procedure

The first step that is done in the research is to formulate what to record. This was accomplished by doing a review of literature, as well as researching for a word list. The list of words, which were carefully selected, were then placed into three categories for the three tests. For the picture test, the words that were easy to display visually were chosen. For the sentence test, words were selected words to form two logically sound sentences. The word list contains the remaining words which were unused. The benefit of choosing subjects from the same classroom is that the researcher (and teacher) has knowledge over their English knowledge. All of the words used for the test are words that have been used in their lessons or those they are already familiar with. There are a total of 18 words in the three tests– the voiced and voiceless dental fricatives are distributed evenly both in the tests and their occurring positions (initial, medial, and final). The tests can be found in the appendix.

The students were let inside the classroom one by one, then they fill in the questionnaire, and finally they had their speech recorded. The recording was then transcribed and categorized into substitutions for all fifteen subjects. To maintain validity, when in doubt, the segment or word is processed in the phonetic analysis computer program PRAAT (also the Dutch word for ‘talk’) for a spectrogram analysis. The view range of the spectrogram is from 0 Hz to 10,000 Hz and the segment produced by the participants are compared to the ‘ideal’ voiceless and voiced dental fricatives as shown in the book *Vowels and Consonants: An Introduction to the Sounds of Languages* by Peter Ladefoged (2001) page 55 and 58 respectively. The results are then organized inside Microsoft Excel spreadsheet (raw data provided in the appendix). Then, the SPSS program is used to analyze the data statistically by means of Repeated ANOVA tests and analysis of percentage (SPSS calculations for Repeated ANOVA and percentage analysis is provided in the appendix). The research paper is then written by utilizing both quantitative and qualitative methods. The quantitative data is used descriptively from the statistics and frequency of errors while the qualitative utilized Optimality Theory to analyze the data and is the focus of this research.

Using the PRAAT program may be confusing at first. PRAAT was found through the internet, and was downloaded as a freeware program. Then, there are web links to manuals on how to use PRAAT. The program has many uses, so it is important to identify what is the object of analysis or the desired result before continuing. For this research, the desired result is to distinguish between certain consonants and the object of analysis are individual segments. Thus, the most relevant tool would be a spectrographic analysis. Prosody and vowels are not incorporated, so that leaves many other tools available in PRAAT obsolete. Some examples are pitch, formant, and pulse analysis. Voice onset time may also be used to identify stop consonant sounds, but this research only uses spectrographic analysis as phonetic manuals like Ladefoged’s book emphasizes the energy distribution distinction in spectrograms to distinguish between the stops and fricatives (which is what the research is doing). The sound files that are uploaded from the recorder to the computer is opened through PRAAT, and analyzed through the *Spectrum* dropdown tab.

3.4 Conclusion of Methods

As a conclusion, there are 15 participants that participated in the three tests in this experiment. Despite their heterogeneity, their English competence (based on the questionnaires collected) is very similar. The three tests include a describing pictures test, reading sentences test, and reading a word list test. Methods of analysis use both qualitative and quantitative. Statistics from SPSS and phonetic analysis using PRAAT is also used as primary data.

CHAPTER 4
FINDINGS AND DISCUSSION

4.1 Findings

The experiments show that there has been a slight deviation in the substitutions of dental fricatives in English. It turns out that the aspirated /t□/ is produced as the output in the substitution process. Moreover, other possible substitutes that were closer to the input in terms of manner and/or place are minor in number in comparison to the alveolar stops. Although the /t□/ is an allophonic variation of /t/ (and thus imposes no difference in meaning), it will still be categorized as a separate substitution for the sake of comprehensiveness.

The summary of the data can be found in percentage form on charts 4.1 and 4.2 below. The percentage shown represents the occurrences of each realisation. Contrary to the prediction, the results are significantly dominant towards other substitutions with a marked difference in frequency. Some substitutions that were originally predicted to occur did not emerge. /s/ and /f/ are used in a very low frequency while /z/ was not used at all. In total, there are 135 repetitions of each dental fricative by the 15 participants.

4.1.1 Output of the Voiceless Dental Fricative /θ/

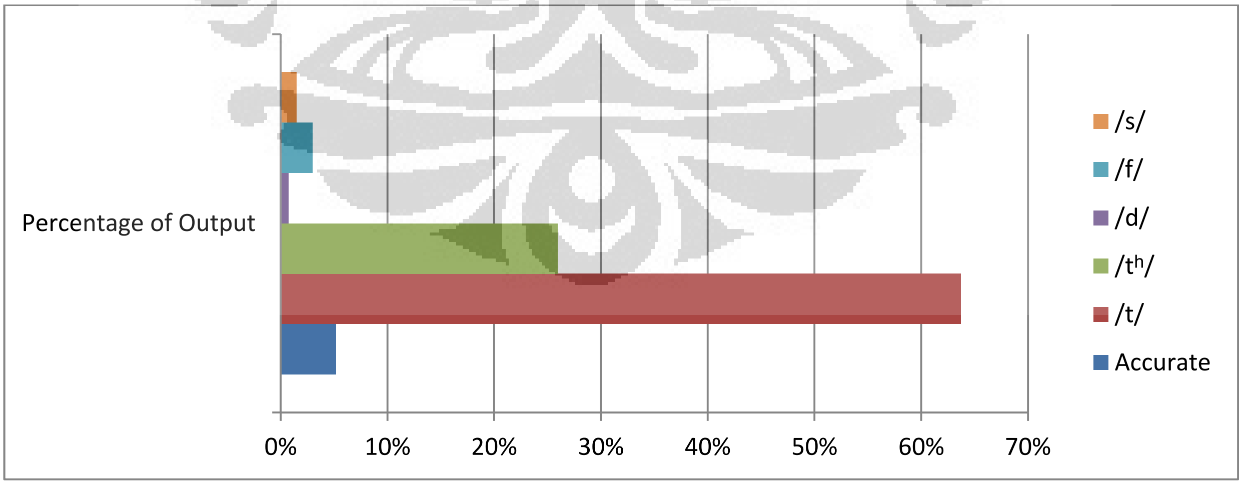


Figure 4.1. Output percentage of /θ/

In the chart above, the frequency of usage of each substitution is shown. The voiceless alveolar stop /t/ and its allophone /t□/ dominated the substitution choice with 63.7% and 25.93% usage respectively. The other substitutions were minor in frequency with the accurate pronunciation of /θ/ coming up at 5.19%. /s/ and /f/ are next with 1.48% and 2.96% respectively. /d/ is below 1% with only 1 repetition using /d/ as a substitute. Repeated ANOVA tests reveal that as a whole, /t/ and its allophone /t□/ is used significantly more than all other substitutions. /t/ is also significantly more frequent than /t□/. Other substitutes do not differ between each other significantly and are very small in number. All possible substitutes are depicted for the sake of completeness.

Descriptive Statistics

	Mean	Std. Deviation	N
t	5.7333	1.70992	15
t□	2.3333	.97590	15
d	.0667	.25820	15
f	.2667	.59362	15
v	.0000	.00000	15
s	.1333	.35187	15
z	.0000	.00000	15

Table 4.1. Mean and Standard Deviation of /θ/ Output

The mean shows that /t/ in average is significantly higher than any other possible substitute with the standard deviation of /t/ being the highest. The difference between the /t/ and its aspirated allophone is significant even at 95% confidence intervals. The next table will demonstrate this fact. On another note, /f/ is higher than /s/, which is higher than /d/. However, /f/, /s/, and /d/ do not differ significantly in comparison to each other. Accurate responses are not accounted here because the focus will be on the substitutions used to represent the dental fricatives. The difference of segment position in the word (initial, medial, or final) is not depicted on the table and will be discussed in the Optimality Theory analysis section.

Estimates

Substitution	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
t	5.733	.441	4.786	6.680
t□	2.333	.252	1.793	2.874
d	.067	.067	–.076	.210
f	.267	.153	–.062	.595
v	.000	.000	.000	.000
s	.133	.091	–.062	.328
z	.000	.000	.000	.000

Table 4.2. Standard Error and 95% Confidence Intervals of /θ/ Output

The standard error is basically the standard deviation of the sampling distribution–the probability distribution based on a random sample. The confidence interval, on the other hand, is the assurance that if confidence intervals are constructed across the analyses of data of repeated experiments, the value of the parameter will be in line with the value range presented in between confidence intervals. It can be seen that as mentioned previously, the lowest bound at 95% confidence interval of /t/ is much higher than the upper bound of /t□/ given that the data is measured and analysed correctly using the statistical model. /d/ is the least used substitute. To further prove the significance and dominance of /t/ as the most frequent and ideal (thus optimal) substitution for the pronunciation of the phoneme /θ/ by the Indonesian learners of English involved in this experiment, the table below is a repeated ANOVA (Analysis of Variance) test, used for testing item pairs for significant differences in frequency.

Pairwise Comparisons

(I) Substitution	(J) Substitution Pair Comparison	Mean Difference (I–J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
t	t^h	3.400*	.559	.000	2.201	4.599
	d	5.667*	.475	.000	4.648	6.685
	f	5.467*	.559	.000	4.267	6.667
	v	5.733*	.441	.000	4.786	6.680
	s	5.600*	.456	.000	4.623	6.577
	z	5.733*	.441	.000	4.786	6.680
t^h	t	–3.400*	.559	.000	–4.599	–2.201
	d	2.267*	.267	.000	1.695	2.839
	f	2.067*	.345	.000	1.328	2.806
	v	2.333*	.252	.000	1.793	2.874
	s	2.200*	.262	.000	1.638	2.762
	z	2.333*	.252	.000	1.793	2.874
d	t	–5.667*	.475	.000	–6.685	–4.648
	t^h	–2.267*	.267	.000	–2.839	–1.695
	f	–.200	.145	.189	–.510	.110
	v	.067	.067	.334	–.076	.210

	s	–.067	.118	.582	–.320	.187
	z	.067	.067	.334	–.076	.210
f	t	–5.467*	.559	.000	–6.667	–4.267
	tʰ	–2.067*	.345	.000	–2.806	–1.328
	d	.200	.145	.189	–.110	.510
	v	.267	.153	.104	–.062	.595
	s	.133	.192	.499	–.278	.545
	z	.267	.153	.104	–.062	.595
v	t	–5.733*	.441	.000	–6.680	–4.786
	tʰ	–2.333*	.252	.000	–2.874	–1.793
	d	–.067	.067	.334	–.210	.076
	f	–.267	.153	.104	–.595	.062
	s	–.133	.091	.164	–.328	.062
	z	.000	.000	.	.000	.000
s	t	–5.600*	.456	.000	–6.577	–4.623
	tʰ	–2.200*	.262	.000	–2.762	–1.638
	d	.067	.118	.582	–.187	.320
	f	–.133	.192	.499	–.545	.278
	v	.133	.091	.164	–.062	.328
	z	.133	.091	.164	–.062	.328
z	t	–5.733*	.441	.000	–6.680	–4.786
	tʰ	–2.333*	.252	.000	–2.874	–1.793
	d	–.067	.067	.334	–.210	.076

	f	–.267	.153	.104	–.595	.062
	v	.000	.000	.	.000	.000
	s	–.133	.091	.164	–.328	.062

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Table 4.3. Repeated ANOVA Tests on Each Substitution Pair of /θ/

When the position of the segment and the different tests involved are disregarded, one can conclude that the dominant substitute for the English voiceless dental fricative /θ/ for Indonesian learners is /t/. Assuming $p<0.05$ (significance is achieved when the value of column Sig.[a] is below 0.05), /t/ is tested in the repeated ANOVA tests as significantly higher than any contending substitute, presenting 0.00 significance rate against other possibilities.

The allophone /t□/ is the runner up having a significantly higher frequency when paired against possible substitutes /d/, /f/, and /s/, but is significantly lower than the phoneme /t/. The voiced counterpart of /t/, /d/ is significantly lower in comparison to /t/ and its allophone. However, although /d/ has the lowest mean (0.67) and is the lowest in terms of frequency overall (against substitutes of value, not accounting for /v/ and /z/), it is rated not significantly lower in frequency than /s/ and /f/, which have, respectively, twice and four times the mean of /d/ (0.133 and 0.267). /s/ has the second lowest mean against substitutes that have values, and is significantly lower in comparison to /t/ and the aspirated version /t□/. Despite having half of the mean value of /f/ (0.267), /s/ is not significantly lower than /f/ according to the ANOVA test. /s/ is also not significantly higher than /d/. The two phonemes /v/ and /z/ did not have values and were not used for the substitution of the voiceless dental fricative of English at all. The summary of the inference that can be drawn is that /t/ is the most dominant substitute while /t□/ comes second, and substitutes of minor value that include /f/, /s/, and /d/ are significantly lower than the dominant substitutes but do not have significant difference amongst themselves.

4.1.2 Output of the Voiced Dental Fricative /ð/

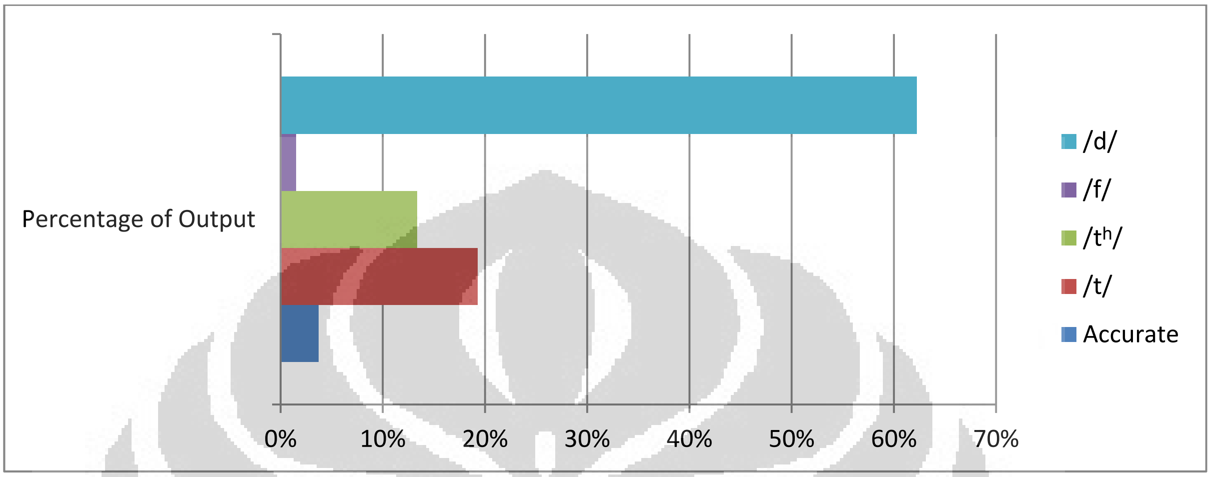


Figure 4.2. Output percentage of /ð/

The frequency percentage of each substitute of value is described in the chart above. The voiced alveolar stop /d/ is the single most dominant substitution choice with 62.22% of the substitute being /d/. It is followed by /t/ and the allophone /t□/ at 19.26% and 13.33% respectively. The other two results did not achieve great numbers in terms of frequency–with accurate pronunciation of /ð/ at 3.7% and /f/ at 1.48%. The repeated ANOVA tests and investigation on the value of means, standard deviation, standard error, and confidence intervals reveal that /d/ is used significantly more than any other substitution. However, /t/ in this case is different from the previous case where their mean values in comparison to its allophonic aspirated variation differ significantly, now it does not have a significant difference. There are, however, significant differences among the non–dominant substitutes (i.e. /t/, /t□/, and /f/). This will be interesting to note since /t/ and /t□/ did not maintain dominance over the two dental fricatives of English. The calculations from the SPSS will be provided in the appendix, and the tables provided here only show the outcome of the calculation by SPSS. All possible substitutes with the exception of accurate responses (which account for 3.7% of the data) will be shown for the sake of completeness. The following table shows the mean and standard deviation of the data set.

Descriptive Statistics

	Mean	Std. Deviation	N
t	1.7333	1.16292	15
t□	1.2000	.86189	15
d	5.6000	.82808	15
f	.1333	.35187	15
v	.0000	.00000	15
s	.0000	.00000	15
z	.0000	.00000	15

Table 4.4. Mean and Standard Deviation of /ð/Output

The mean column shows that /d/ is the most dominant substitute and the average is higher than any other possible substitute with the second lowest standard deviation. /t/ has the highest standard deviation while /f/ has the lowest of both mean and standard deviation. The mean value of /d/, however, is less dominant than that of /t/ on the previous analysis of the voiceless dental fricative. This shows that there are more prominent contenders as the optimum substitute of the voiced dental fricative. Again, accurate responses are omitted since the focus on the representations of dental fricatives that may be classified as substitutes. There are less competing substitutes in the voiced dental fricative in comparison to its voiceless counterpart, indicating that the less dominant substitutes have more value as opposed to the very little frequency the non–dominant substitutes have on the previous output concerning the voiceless dental fricative. As with the previous results, the segmental positions in a word are not informed as this is an overall summary of the study, and the more detailed analysis of each position of each dental fricative will be discussed in the OT analysis section.

Estimates

Substitution	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
t	1.733	.300	1.089	2.377
t□	1.200	.223	.723	1.677
d	5.600	.214	5.141	6.059
f	.133	.091	–.062	.328
v	.000	.000	.000	.000
s	.000	.000	.000	.000
z	.000	.000	.000	.000

Table 4.5. Standard Error and 95% Confidence Intervals of /ð/ Output

As with the previous table, the data speaks for itself. The lower bound confidence interval of the dominant substitute /d/ is over twice that of the upper bound of the runner up /t/. However, the aspirated counterpart of the voiceless alveolar plosive has an upper bound that exceeds the non–aspirated version's lower bound. /f/ is the least used to substitute the phoneme. While the frequency of /d/ can be easily proven to be significantly higher over other substitutes, /t/ and /t□/ have doubtfully similar values. /f/ is surely the significantly lowest in its substitution occurrence with its upper bound lower than the second lowest phoneme's (/t□/) lower bound. To clarify the assumptions of significance and non–significance over other substitutes, another repeated ANOVA tests are carried out where each substitute is paired with another and tested against each other for significant differences.

Pairwise Comparisons

(I) Substitution	(J) Substitution	Mean Difference (I–J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
t	th	.533	.487	.292	–.510	1.577
	d	–3.867*	.350	.000	–4.617	–3.116
	f	1.600*	.335	.000	.881	2.319
	v	1.733*	.300	.000	1.089	2.377
	s	1.733*	.300	.000	1.089	2.377
	z	1.733*	.300	.000	1.089	2.377
th	t	–.533	.487	.292	–1.577	.510
	d	–4.400*	.289	.000	–5.021	–3.779
	f	1.067*	.248	.001	.534	1.599
	v	1.200*	.223	.000	.723	1.677
	s	1.200*	.223	.000	.723	1.677
	z	1.200*	.223	.000	.723	1.677
d	t	3.867*	.350	.000	3.116	4.617
	th	4.400*	.289	.000	3.779	5.021
	f	5.467*	.215	.000	5.005	5.928
	v	5.600*	.214	.000	5.141	6.059
	s	5.600*	.214	.000	5.141	6.059

	z	5.600*	.214	.000	5.141	6.059
f	t	–1.600*	.335	.000	–2.319	–.881
	tʰ	–1.067*	.248	.001	–1.599	–.534
	d	–5.467*	.215	.000	–5.928	–5.005
	v	.133	.091	.164	–.062	.328
	s	.133	.091	.164	–.062	.328
	z	.133	.091	.164	–.062	.328
v	t	–1.733*	.300	.000	–2.377	–1.089
	tʰ	–1.200*	.223	.000	–1.677	–.723
	d	–5.600*	.214	.000	–6.059	–5.141
	f	–.133	.091	.164	–.328	.062
	s	.000	.000	.	.000	.000
	z	.000	.000	.	.000	.000
s	t	–1.733*	.300	.000	–2.377	–1.089
	tʰ	–1.200*	.223	.000	–1.677	–.723
	d	–5.600*	.214	.000	–6.059	–5.141
	f	–.133	.091	.164	–.328	.062
	v	.000	.000	.	.000	.000
	z	.000	.000	.	.000	.000
z	t	–1.733*	.300	.000	–2.377	–1.089
	tʰ	–1.200*	.223	.000	–1.677	–.723
	d	–5.600*	.214	.000	–6.059	–5.141
	f	–.133	.091	.164	–.328	.062

	v	.000	.000	.	.000	.000
	s	.000	.000	.	.000	.000

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the .05 level.

Table 4.6. Repeated ANOVA Tests on Each Substitution Pair of /ð/

In this case, without paying heed to segmental position (i.e. whether it is in the initial, medial, or final position) and the different tests used to gather data, the conclusion is that the dominant substitute for the English voiced dental fricative /ð/ is the voiced alveolar stop /d/. With the assumption of $p<0.05$ (significant difference is depicted with the value of sig>0.05), /d/ is tested against all other substitutes by means of repeated ANOVA yielding 0.00 significance rate on each one–meaning that it is absolutely and significantly different (higher frequency) in comparison to the other substitutes.

The previous dominant substitute /t/ comes second having significantly higher (0.00 Sig.[a]) mean in comparison to /f/, and significantly lower in comparison to /d/. However, unlike the data sets for the substitution of /θ/, the difference in mean between the substitute /t/ and its allophonic variation /t□/ is not significant (0.292 Sig.[a]). The inference that can be drawn from here is the fact that frequency difference between the two phonemes are insignificant, and thus the combination of the two constitute the runner up substitute of the voiced dental fricative of English. /f/, which has the lowest frequency out of all substitutes with value, has almost one ninth of the mean value of the second lowest frequency /t□/ and is significantly lower in frequency in comparison to others. The phonemes /v/, /s/, and /z/ were not used as substitutes at all while /s/ was used previously. To summarize, it is clear that /d/ is extremely dominant, yielding significance against all substitutes while /t/ and /t□/ comes second and third respectively without significant difference between the two. /f/ has the least mean and comes last with its frequency being significantly lower than all others.

4.2 Discussion

It is worthy to note that even though obvious patterns of substitution have been proven from the display of statistics on the previous subchapter, intra–subject variation within variables is quite large–with some individuals having differing substitution usage even in the same word position between different tests. The findings show that Indonesian learners of English as the participants do indeed substitute the dental fricatives of English on a frequent basis. The combined accuracy rate of the two dental fricatives amount to a mere 4.45%. The subjects failed to pronounce accurately the fricatives in over 95% of the samples. In this discussion, I will go through each word position and analyze the significantly dominant substitute through an Optimality Theory analysis.

With reference to the previous chapter, the Optimality Theory has categorized major hierarchies of constraints. The two major constraints that I will use in this research are the FAITHFULNESS (often referred to as correspondence) and MARKEDNESS constraint. Major constraint hierarchy is often capitalized when it is used to refer to a constraint (not its traits).

The FAITHFULNESS constraint of a language demands the output (realization) to be similar or exactly the same to the input (target). The MARKEDNESS constraint, on the other hand prohibits segments or words with more marked elements to be realized. This will obviously cause a clash between the two constraints, since the accurate realization of dental fricatives would undoubtedly violate many constraints under the label of MARKEDNESS as those phonemes are universally marked. Conversely, the act of assimilation or substitution of phonemes would violate a set of constraints under FAITHFULNESS that makes sure the output resembles the input segmentally. The only way out of the conflict is the assignment of values to each constraint, having a dominant and one or several lesser constraints to decide on the optimal substitute. In the analysis, one will find out what constraints are involved in producing the optimal substitution of the dental fricatives of English. It is also important to note that different constraints may surface on different cases, and the constraints may or may not have different values in each case.

4.2.1 An Optimality Theory Analysis of /θ/ in the Initial Position

The three tests use three words to represent the usage of a voiceless dental fricative in the initial position, one in each test. Each participant repeats the segment once with a total of 45– 15 repetitions for each word (one word in one test). Below is a table reflecting the summary of substitution frequency for the voiceless dental fricative in the initial position of a word.

	Frequency	Percent	Cumulative Percent
Accurate	2	4.4	4.4
t	28	62.2	66.7
t□	14	31.1	97.8
d	1	2.2	100.0
Total	45	100.0	

Table 4.7. Output for /θ/ in the Initial Position

The first word tested in the picture test is thirty /□θ□ː t□/ (pronounciation guideline is acquired from *Oxford Advanced Learner's dictionary* 7th edition). *Thirty* was a sensible word to test since the pronunciation of this word was explicitly taught in class. Thus, 'thirty' is used to represent the usage of initial dental fricatives by the participants. The other two words are *thanks* and *Thursday*. 5 out of 15 subjects used /t□/ as a substitute while the rest (10 out of 15) uses /t/ in pronouncing *thirty*. This is quite interesting as the graphemes of *thirty* show an obviously stated *h*, but the output has proven that most participants ignore the temptation to produce the *h* in an aspiration and instead produce a flat voiceless alveolar plosive /t/. A spectrogram of a female participant using the most optimal substitution to pronounce *thirty* can be seen as follows (taken from participant number 15):

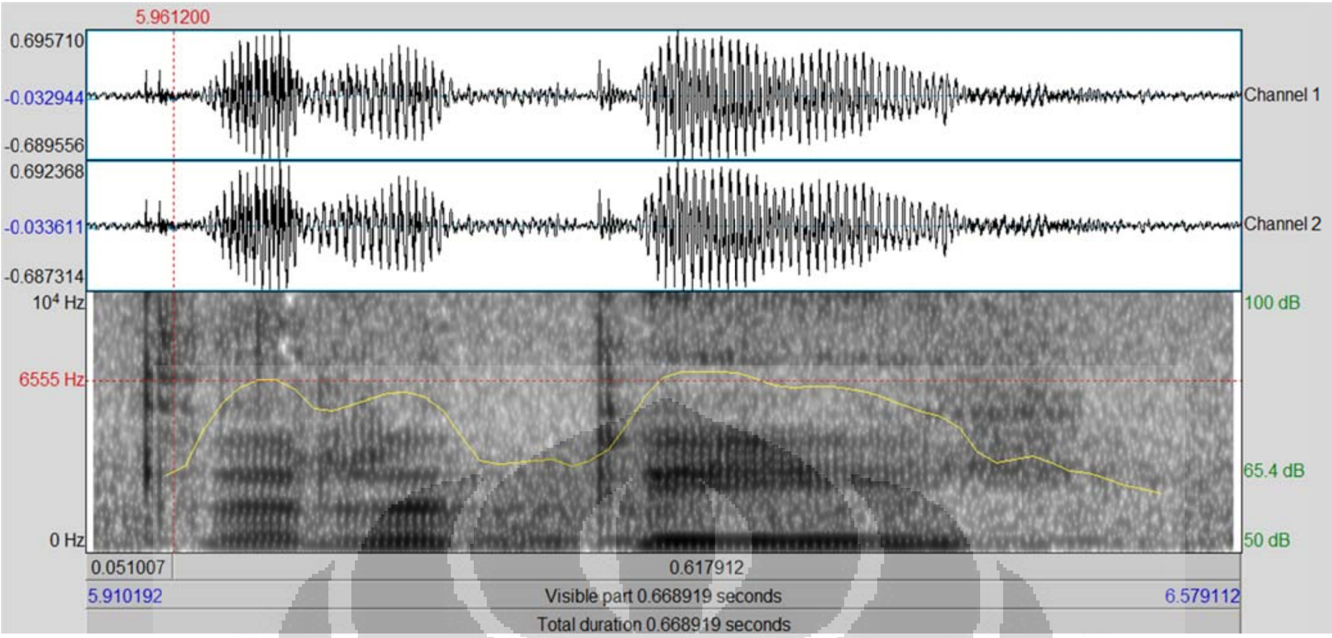


Figure 4.3. spectrogram and waveform of realization *thirty* /t □r ti/

The intersection of the faint red lines at the 51st millisecond indicates the energy (around 5000 Hz to 7000 Hz is the intensive point) of the initial voiceless stop /t/ as opposed to the initial /θ/ which would have faint energy up to 7000 Hz, and intense burst of energy from 7000 Hz to 10000 Hz. The spectrum range is from 0 Hz to 10000 Hz. Other deviations concerning difference in vowel and realization of the rhotic is largely insignificant to this research and are not discussed. The aspirated allophone of /t/ is also classified as /t/ as it bears no difference in terms of the constraints involved.

The fact that /t/ becomes the optimal substitution for /θ/ in the initial position proves that the dominant constraint is of MARKEDNESS quality. The constraint tableau is as follows (Segmental Markedness >>Ident[Feat]):

/θ/ in/□θa: ti/	Segmental Markedness	Ident[Feat] (PoA, MoA, Voice)
☞ /t/		**
/d/	*!	***!
/f/	**!	*
/s/	*!	*

Table 4.8. Constraint Tableau for /θ/ in the Initial Position

As it is the first constraint tableau, /f/ and /s/ that did not occur in the initial position were also inserted for the sake of completeness. The optimality of /t/ is achieved through the dominance of the segmental markedness constraint. The phoneme /d/ fatally violated both constraints by achieving a marked status through voicing and being different in all three areas in comparison to the source (in place and manner of articulation and voicing). /f/ is suboptimal because it fatally violates the constraint of segmental markedness twice for being [+continuant; –strident]. /s/ fatally violates the segmental markedness constraint by being a continuant. Therefore, /t/ is the most optimal substitute for the initial position voiceless dental fricative due to its non–markedness and non–fatal violation of the constraint Ident[Feat].

4.2.2 An Optimality Theory Analysis of /θ/ in the Medial Position

Three words are used to represent the usage of voiceless dental fricative in the medial position, namely *birthday, healthy,* and *athlete*. Each participant pronounces the words with the voiceless dental fricative in the medial position three times with a total of 45– with 15 repetitions each word. Shown below is a table representing the summary of the whole substitution frequency for the voiceless dental fricative in the medial position:

	Frequency	Percent	Cumulative Percent
Accurate	4	8.9	8.9
t	29	64.4	73.3
t□	8	17.8	91.1
f	2	4.4	95.6
s	2	4.4	100.0
Total	45	100.0	

Table 4.9. Output for /θ/ in the Medial Position

The output of /θ/ in the middle position offers more variety in comparison to its initial counterpart. Other substitutes include the /f/ and /s/. These two substitutes do not exist in the initial position. The second most dominant substitute remains the aspirated allophone of /t/ though. The first word tested in the picture test is *birthday*, the second in the sentence test is *healthy*, and the third test, which is the wordlist, has *athlete*. For the sake of representing the three, *birthday*, which is pronounced as /□b□:θde□/ (BrE, taken from *Oxford Advanced Learner's dictionary* 7th edition), is taken as the input. This informed decision is taken because the word is highly familiar for the students. The significantly dominant realization of the input is shown in the spectrogram below:

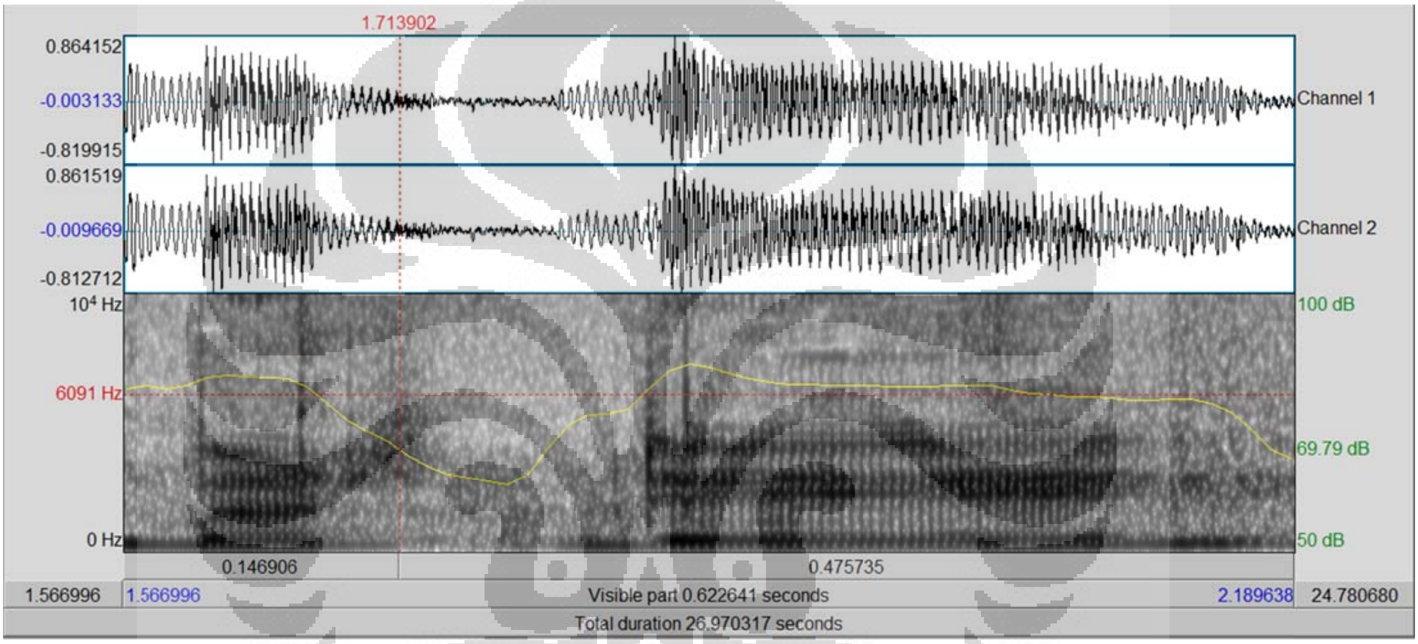


Figure 4.4. spectrogram and waveform of realization *birthday* /□b□rtde□/

The intersection of the dotted red lines at the 146th millisecond indicates the energy (around 5000 Hz to 7000 Hz is the intensive point) of the medial voiceless plosive /t/ as opposed to the medial /θ/ which would have faint energy up to 7000 Hz, and intense burst of energy from 7000 Hz to 10000 Hz. The spectrum range is from 0 Hz to 10000 Hz. The /t/ is preceded by the rhotic /r/ and the previous syllable. Other differences between the input and the realization concerning difference in realization of the rhotic are largely insignificant to this research and are not discussed. The aspirated allophone of /t/ is also classified as /t/ as it has no difference in terms of the constraints involved. A quite interesting fact about *birthday* is that each of the two substitution deviations /f/ and /s/ occur.

This, however, bears no significance since /t/ is dominant with occurrences in 9 out of 15 repetitions. 2 out of 15 are accurate while the 4 remaining repetitions are /f/ and /s/. Other words with /θ/ in the medial position show much more dominance in /t/ with 14 out of 15 occurrences of /t/ and its aspirated allophone in the repetitions of *healthy*. This is also true for the word in the third test– *athlete* procuring 14 out of 15 /t/ and its allophone and 1 accurate response.

Despite emerging contenders /f/ and /s/, /t/ and its allophone are still very dominant. The fact that /t/ becomes the optimal substitution for /θ/ in the medial position shows that the dominant constraint involved in the optimization process is of MARKEDNESS quality. The constraint tableau is as follows (Segmental Markedness >>Ident[Feat]):

/θ/ in/□b□:θde□/	Segmental Markedness	Ident[Feat] (PoA, MoA, Voice)
☞ /t/		**
/f/	**!	*
/s/	*!	*

Table 4.10. Constraint Tableau for /θ/ in the Medial Position

The constraint interaction resembles the tableau for the previous analysis. This implies that there are no major differences in the optimal substitution of /θ/ between the initial and medial position. The segmental markedness is the dominant constraint in the tableau above, awarding the phoneme /t/ optimal status. The phonemes /f/ and /s/ are suboptimal despite the fact that a few participants use them. Quantitatively speaking, /f/ and /s/ are significantly lower in frequency, implying the dominance of the optimality of /t/. It is worth noting that the phoneme /d/ did not occur in the medial position at all, indicating the importance of voicelessness as both a segmental markedness constraint (/d/ is voiced) and the Ident[Feat] constraint which demands the voicing of the substitute to resemble the input (/θ/ is voiceless while /d/ is voiced). In comparison between the two tableaus, medial position places emphasis on voicing resemblance and perhaps identicalness in features (PoA, MoA, and voicing) of input to output seeing that the realization /d/ does not occur where /f/ and /s/ does.

4.2.3 An Optimality Theory Analysis of /θ/ in the Final Position

Tooth, *math*, and *path* are used to represent the usage of the English voiceless dental fricative in the final position. They are distributed evenly among the three tests. Each participant pronounces the words once making a total of 45 repetitions (15 for each word). Shown in the table below is the summary of frequency of substitution for the /θ/ in the word–final position depicted using a table:

	Frequency	Percent	Cumulative Percent
Accurate	1	2.2	2.2
t	29	64.4	66.7
t□	13	28.9	95.6
f	2	4.4	100.0
Total	45	100.0	

Table 4.11. Output for /θ/ in the Final Position

The final position output of /θ/ is slightly different from both the initial and medial positions. Similar to the initial it has only one alternate substitution, which is /f/. The most dominant substitute is still consistently /t/ followed by its allophonic variation. Other substitutes remain insignificant. The first word, *tooth* /tu:θ/ (BrE, taken from *Oxford Advanced Learner's dictionary* 7th edition) is chosen because there is the occurrence of a varying substitute /f/, and also because it is a well known and basic word. Students should be able to recognize the input immediately and (supposedly) know what to produce. To represent the three words as outputs for the voiceless dental fricative in the final position, *tooth* is analysed by means of waveform and spectrogram analysis.

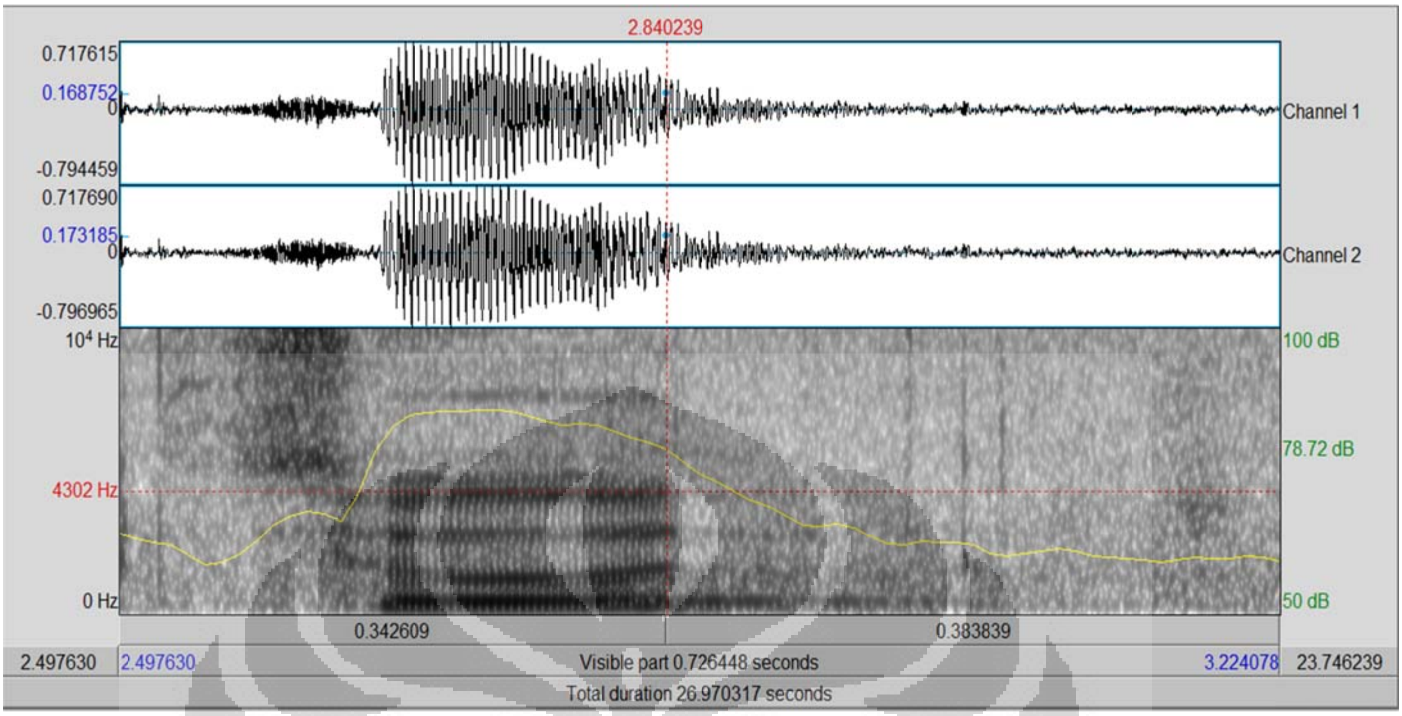


Figure 4.5. spectrogram and waveform of realization *tooth* /tu:t/

The intersection of the dotted red lines at the 342nd millisecond indicates the energy of the final voiceless plosive /t/ as opposed to the final /θ/ which would have faint energy up to 7000 Hz, and intense burst of energy from 7000 Hz to 10000 Hz. The spectrum range is from 0 Hz to 10000 Hz. The /t/ is preceded by a syllable and is used to end the word. The yellow line indicates intensity of the spectrum, when the vowel of the syllable is voiced, the intensity rises (formants) and at the point of the final stop, the intensity lowers (marked by the dotted red lines). This is the only sample discussed that has realizations which are minimal pairs with the input, differing only in the final consonantal sound. Another fact regarding the sample analysed (*tooth*) is that the allophonic variation of the phoneme /t/ has low frequency. 2 out of 15 repetitions use /t□/. This is uncommon because the total of final realization puts the /t□/ at 28.9%, almost one–third of all the responses. It is underrepresented in *tooth*, with /t/ as the most dominant one.

Even though there is another substitute which is /f/ (occurring at the rate of 1 out of 15 in *tooth)*, /t/ is still very dominant. The fact that /t/ becomes the optimal substitution for /θ/ in the final position shows that the dominant constraint involved in the optimization process is of MARKEDNESS quality. The constraint tableau is as follows (Segmental Markedness>> Ident[Feat]):

/θ/ in /tu:θ/	Segmental Markedness	Ident[Feat] (PoA, MoA, Voice)
☞ /t/		**
/f/	**!	*

Table 4.12. Constraint Tableau for /θ/ in the Final Position

The interaction of constraints here is similar to the tableau of the previous analyses. This is a further confirmation that there are no major differences in the optimal substitution of /θ/ between any of the positions. As with the previous constraint conflicts, the segmental markedness constraint is predominant, making the phoneme /t/ the most optimal substitute to use as a replacement for the voiceless dental fricative in English. /f/ is suboptimal even though, phonologically speaking, it is more similar to the input phoneme. It has the same voicing and manner, but a different place of articulation in comparison to the input phoneme (labiodental vs dental).

As a conclusion of optimal substitution of phoneme /θ/ by Indonesian learners of English as the participants, /t/ is the most optimal substitute for the English voiceless dental fricative. From the point of view of optimality theory, this is because of the dominance of the constraint called segmental markedness (which demands the use of unmarked segments) over the dominated faithfulness constraint that demands the retention of the features of input segments (best realized with the input exactly resembling the output). There are also other minor substitutions made– those which are suboptimal in terms of substituting for the voiceless dental fricative. This includes /d/ (2%), /f/ (9%), and /s/ (4%). The aspirated /t/ and /t/ themselves maintain dominance occurring at almost 85% of the total substitution regardless of segment position in a word.

4.2.4 An Optimality Theory Analysis of /ð/ in the Initial and Medial Position

The discussion of the substitution of voiced dental fricative in the initial and medial positions is combined into one subchapter because the two yield extremely similar results. The initial position uses three very common words with grammatical function, which are *this*, *the*, and *there*. The three words used to represent the usage of /ð/ in the medial position are *father*, *weather*, and *together*. Below are two tables showing the summary of the substitution frequency for /ð/ in the word–initial and word–medial positions:

	Frequency	Percent	Cumulative Percent
Accurate	1	2.2	2.2
t	1	2.2	4.4
d	43	95.6	100.0
Total	45	100.0	

Table 4.13. Output for /ð/ in the Initial Position

	Frequency	Percent	Cumulative Percent
Accurate	2	4.4	4.4
t	1	2.2	6.7
t□	1	2.2	8.9
d	41	91.1	100.0
Total	45	100.0	

Table 4.14. Output for /ð/ in the Medial Position

Both the initial and the medial position are dominated by /d/ with the substitutes occurring at a rate of 95.6% and 91.1% respectively. There are only two deviations of the same type, which are /t/ and its allophone /t□/. The rate of alternative substitution is very low with only 2 percent occurrence rate of non–/d/ responses each. The accuracy rate of the initial and medial voiced dental fricatives is much lower than its voiceless counterpart at 2.2% and 4.4% compared to 4.4% and 8.9% respectively. The voiced dental fricative is indeed more marked than the voiceless one, but whether this fact affect the optimization of a substitute or not is the fact we will find out. Chosen as a sample to represent the six words from three tests are *there* for the initial position and *father* for the medial position. The phonetic transcription of *Father* is /'f□:ðə/. *There* is transcribed as /ðeə/ (both transcriptions are BrE, taken from *Oxford Advanced Learner's dictionary* 7th edition). The two representations are analysed in a spectrogram analysis.

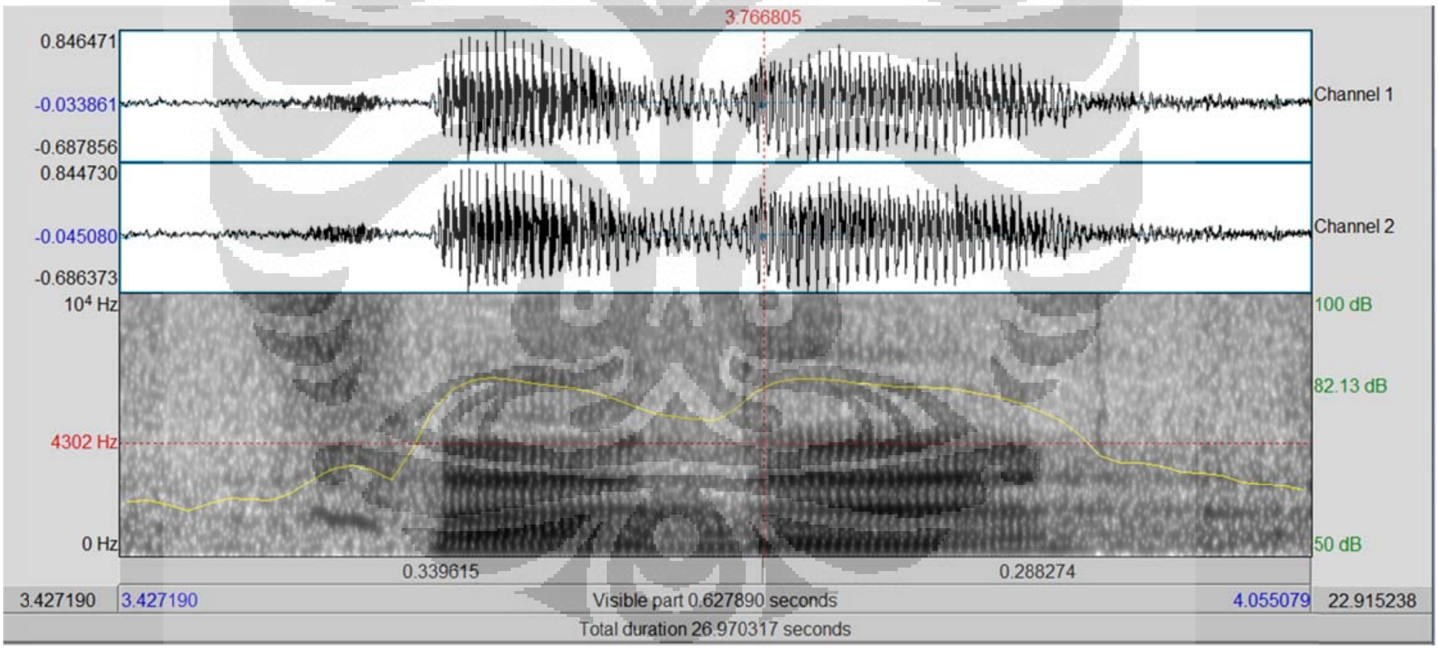


Figure 4.6. spectrogram and waveform of realization *father* /'f□:də/

In identifying the phoneme /d/ and distinguishing it from the input /ð/, one must first classify the characteristics of /ð/ in a spectrogram. Ladefoged (2001: 58) stated that "voiced fricatives have formants produced by pulses from the vocal folds as well as more random energy produced by forcing air through a narrow gap." implying that they have little random energy in the higher frequencies, particularly above 5000 Hz. Observing the red dotted intersection, one will find that it is the location of the voiced plosive /d/ with stable bursts of energy below 5000Hz through the turbulence caused by vocal fold vibration. Intensity (the yellow line) rises as the voiced stop transitions into a vowel.

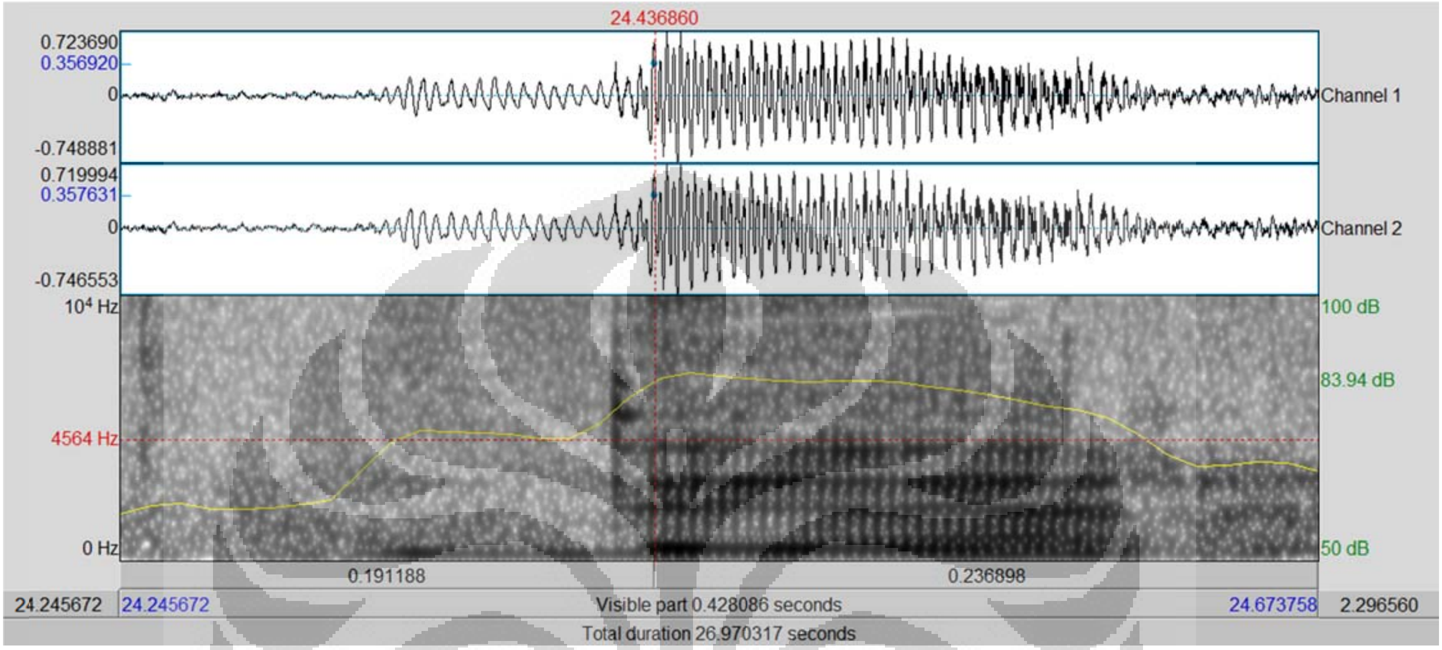


Figure 4.7. spectrogram and waveform of realization *there* /deə /

The above spectrogram also shows stable energy output in the dotted red line intersection (which signifies the consonant sound), and little to no random energy outbursts at 7000 Hz to 10000 Hz which is a distinct sign of the voiced dental fricative /ð/. The marked intensity rises prior to vowel with the production of /d/.

The fact that /d/ is an optimal output of the initial and medial position proves that this time, segmental markedness constraint does not fully dominate the optimization. The constraint tableau for the combination of initial and medial position can be seen below (Ident[Voice]>> Segmental Markedness):

/ð/ in /'f□:ðə/ and /ðeə/	Ident[Voice]	Segmental Markedness
☞ /d/		*
/t/	*!	

Table 4.15. Constraint Tableau for /ð/in the Initial and Medial Position

The constraint Ident[Voice] means the constraint favours outputs in which voicing corresponds to the input. In this case, /t/ has violated this constraint by being a voiceless stop as opposed to being a voiced consonant. In pronouncing /ð/ the most optimal substitute would be the one which has corresponding voicing since /f/ and /s/ do not even occur in the data sets. Ident[voice] is therefore the dominant constraint, dominating over the previous dominance, the constraint Segmental Markedness. /d/ has violated a constraint of Segmental Markedness as whole since /d/ is voiced and voiced consonants are more marked than its voiceless counterpart is. However, this does not prove to be significant as /t/ has fatally violated the dominant constraint Ident[voice], and thus /t/'s advantage over not violating the other competing but weaker constraint is insignificant (shaded in gray to indicate violation values in that column/row are not of essence). To summarize, the most optimal substitute for the voiced dental fricative is /d/ due to its voicing correspondence. /d/ is more optimized than /t/ since /t/ does not correspond with the input in terms of voicing although /t/ has a perfect score of 0 violation in terms of the less dominant constraint Segmental Markedness.

4.2.5 An Optimality Theory Analysis of /ð/ in the Final Position

While the discussion of the the initial and medial positions is combined into one subchapter, the final position of /ð/ will be discussed individually since it has highly varying results when compared to other positions. The final position uses three verbs as the tests, which are *breathe*, *bathe*, and *clothe*. Below is the table showing the results of substitution frequency for /ð/ in the final position of a word:

	Frequency	Percent	Cumulative Percent
Accurate	2	4.4	4.4
T	24	53.3	57.8
t□	17	37.8	95.6
F	2	4.4	100.0
Total	45	100.0	

Table 4.16. Output for /ð/ in the Final Position

Accuracy rate remains low as other voiced dental fricative outputs show. However, there is a massive difference between the output of the word–final position of /ð/ in comparison to the initial and medial. The output of the final position does not contain the previously optimal substitution at all. The dominant substitute is /t/, similar to the voiceless dental fricatives, with over 90% of the substitutes using either /t/ or its aspirated allophone. The alternate substitution is /f/, but only 4% of the repetitions use it. It is interesting to note that the phoneme /d/ did not emerge at all seeing that it was a dominant substitute in the two previous positions. The writer uses *bathe* to represent the three words that are tested in three different tests. *Bathe* is phonetically transcribed as /be□ð/ in BrE. Below is a spectrogram analysis of the word:

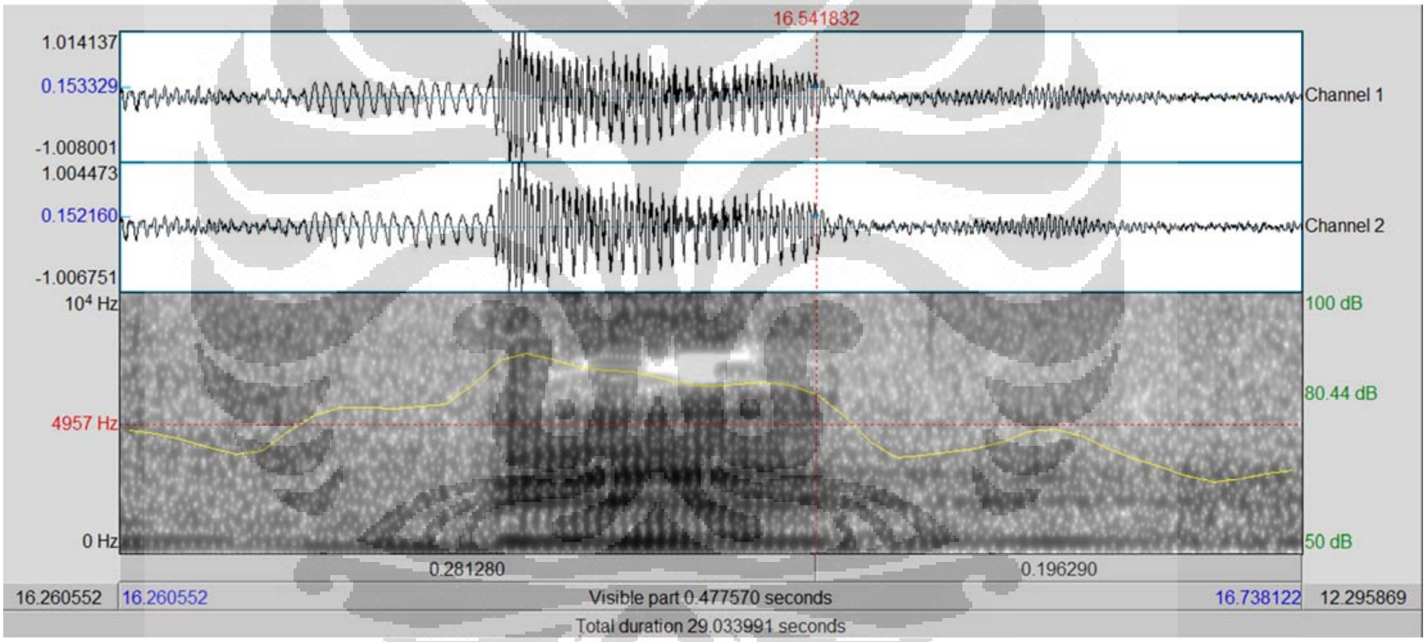


Figure 4.8. spectrogram and waveform of optimal realization *bathe* /bet/

Disregarding the vowel difference between the input and the actual output of the grapheme, the spectrogram displays participant number 12 pronouncing the optimal form /ð/ in the word–final position of *bathe*. The faint red intersection on the 281st milisecond indicates where the /t/ phoneme is sounded. The yellow line which shows intensity lowers after the final consonant /t/ is used, indicating the end of the word. While it is odd to find same results in two different phonemes, it is also logically sound to have unmarked elements to end a word– many voicing assimilations of connected speech in English occur in the word–final position e.g. have to /v/–>/f/. Though *bathe* is presented through connected speech in the sentence test, results of the picture test and the word list show great confidence on the dominance of /t/. *Breathe* on the picture test has 13 out of 15 repetitions realized as /t/ or its aspirated allophone, with 1 accurate response, and 1 /f/ as a substitute. *Clothe* displays even greater frequency of /t/ with the occurrence rate of 14 out of 15 realizations, nihil accurate response, and 1 /f/ as a substitute.

/ð/ in /be□ð/	Segmental Markedness	Ident[Feat] (PoA, MoA, Voice)
☞ /t/		**
/f/	**!	*
/d/	*!	*

Table 4.16. Constraint Tableau for /ð/in the Final Position

The constraint tableau shows a deviation of other optimization processes of the voiced dental fricative in both the initial and medial positions. Firstly, as it was previously mentioned, the phoneme /d/ is so suboptimal that it does not surface even once in the data sets. Secondly, the result slightly resembles the voiceless dental fricative in the final position–with /t/ as the dominant substitute and /f/ as the minor alternative. The phoneme /d/ is also provided in the table because previously, /d/ is the dominant phoneme, thus it would be very much related to the result of the final position (since it is the same phoneme placed in three different locations in a word). The constraint Ident[Voice] is not used anymore since it is not relevant. The voiceless stop /t/ is the most optimal substitute of the voiced dental fricative. In the constraint tableau above, it is indicated that the realization of /ð/ prefers unmarked items as opposed to marked ones, awarding the constraint Segmental Markedness the dominant constraint once more, with Ident[Feat] as the weaker, dominated constraint.

4.3 Conclusion of Findings and Discussion

To summarize the chapter, there is one optimal substitute of the voiceless dental fricative regardless of word position and two optimal substitutes of the voiced dental fricative depending on the position of the segment. /t/ is the optimal substitute for /θ/ regardless of its position. /d/ is the optimal substitute for /ð/ in the word–initial and word–medial positions while /t/ is the optimal substitute for /ð/ in the word–final position.

The major constraint groups that are in conflict are the MARKEDNESS constraint and the FAITHFULNESS constraint. Specifically, the segmental markedness constraint is present in all segment positions in both phonemes. The FAITHFULNESS constraint set are represented with Ident[Feat] and Ident[Voice]– the first representing faithfulness in terms of all segmental features of the input (place and manner of articulation as well as voicing) while the latter refers to resemblance in voicing.

From the statistics, one can conclude that as a substitute for /θ/, /t/ is significantly highest in frequency while its aspirated allophone comes second and is also significantly higher than the rest of the substitutes (/d/, /f/, and /s/) while being significantly lower than /t/. The data sets for /ð/ show that overall, /d/ is significantly higher in frequency than all other substitutes, with /t/ and / t□/ coming second and at the same time being significantly higher than /f/, significantly lower than /d/, and pertaining insignificant difference among each other.

CHAPTER 5
CONCLUSION

5.1 Conclusion

As a conclusion, for Indonesians, /t/ and /d/ are the optimal substitutes of the two dental fricatives of English. More specifically, the /t/ is the sole and most optimal substitute of the voiceless dental fricative regardless of its place in a segment, as well as the word–final position of the voiced dental fricative while /d/ is the optimal substitute of the voiced dental fricative in the word–initial and word–medial positions.

Besides being unmarked, the plosives /t/ and /d/ are preferred as substitutes because they are closer to the grapheme than the other substitutes (say, /f/ or /s/). This is shown by the consistent prevalence (though non–dominant) of the aspirated allophone / t□/ as supposedly an attempt to equalize the produced output with the grapheme of the input. There are of course, limitations to such an assumption. Some of the subjects may have yet to acquire the dental fricatives of English. This is accounted for in this research as the choice of participants reflects greater generalization potential of the study. Then, since the participants are mostly living in major cities like Jakarta (the recording was made in Depok, West Java), generalization may be applied to only those living in urban areas of Indonesia–since perhaps the exposure rate of English in urban areas is greater than those in rural areas.

The normal distribution is also assumed in most of the statistical data since its purpose is to provide a descriptive account of substitutions while the emphasis is on the qualitative analysis using the scope of Optimality Theory.

In congruence with the implication of this study, language teachers instructing speaking and pronunciation have to give extra attention to the students' pronunciation and acquisition process of dental fricatives of English. It is important to note that while optimal substitutions do exist, it may be more desirable for the learners to procure the accurate phoneme itself. One would suggest repeated drills to introduce the phoneme and teach the students to distinguish the phoneme from other possible substitutions. Some substitutes are very similar in terms of phonetic and phonological aspects to the dental fricatives. It is difficult even in a spectrographic illustration to distinguish, for example, /f/ and /θ/. Thus, forcing the acquisition or imposing negativity on those who fail to produce accurate sounds are highly discouraged since intelligibility of speech is not adversely affected by substituting the dental fricatives of English.

5.2 Recommendation

Pronunciation lessons have to focus on areas that have the greatest influence on intelligibility, which are particular segmentals, nuclear stress, and the effective use of articulatory setting. As language teachers, one needs to identify precisely the students' usage of specific segments. Errors in pronouncing dental fricatives, in particular, are notorious. A suggestion that is offered is to instruct on how to actually articulate certain segments. An example would be to showing Figure 2.2 while explaining positions of the articulators when procuring the dental fricatives. Aside from showing and modeling the production of dental fricatives, one may also be able to ask students who have acquired those segments to come to the front and provide a model for the class. It may motivate others who have not yet acquired the dental fricatives to practice more diligently (my classmate is able to do it, so why shouldn't I?). After knowing the positions of articulators, the students may be recommended to practice in front of a mirror to locate the articulators more precisely, therefore easing sound production.

The strategy above may be used for adult learners who have trouble distinguishing between the dental fricatives and their substitutes. This imposes difficulties in acquiring dental fricatives of English naturally by imitating or reproducing segments that one hear. Consequently, adult Indonesian learners of English would need extra help on producing those marked sounds. Younger learners of English (those before or in the Critical Period) can acquire the dental fricatives naturally and are encouraged to do so by getting frequent exposure to standard pronounciation.

Works Cited

Barlow, J., & Gierut, J. (1999). “Optimality Theory in Phonological Acquisition”. *Journal of Speech, Language, and Hearing Research* , *42,* 1482-1498.

Batzarov, Z. (n.d.). *International Phonetic Alphabet.* Retrieved May 2011, 27, from http://www.orbilat.com/General_References/Phonetics/International_Phonetic_Alphabet.html

Brown, D. (2007). *Principles of Language Learning and Teaching.* New York: Pearson Education.

Carey, M. (n.d.). *Phonetics and Phonology: Interlanguage Phonology: Sources of L2 Pronunciation "Errors".* Retrieved May 2011, 27, from Macquarie university Faculty of Human Sciences: http://clas.mq.edu.au/phonetics/phonology/interlanguage/pronerrors.html

Eppert, F. (Ed.). (1983). *Transfer and Translation in Language Learning and Teaching.* Singapore: Singapore University Press.

Flege, J. E. (1987). “The Production of "New" and "Similar" Phones in a Foreign Language: Evidence for the Effect of Equivalence Classification”. *Journal of Phonetics*, *15*, 47-65.

Lacy, P. (2006). *Markedness: Reduction and Preservation in Phonology.* Cambridge: Cambridge University Press.

Ladefoged, P. (2003). *Phonetic Data Analysis.* Oxford: Blackwell Publishing.

Ladefoged, P. (2001). *Vowels and Consonants : an Introduction to the Sounds of Languages.* Oxford: Blackwell.

Lapoliwa, H. (1981). *A Generative Approach to the Phonology of Bahasa Indonesia.* Canberra: Australian National University.

Mckay, S. L. (2002). *Teaching English as an International Language: Rethinking Goals and Approaches.* Oxford: Oxford University Press.

Oxford Advanced Learner's Dictionary 7th Edition. (2005). Oxford: Oxford University Press.

Pardede, P. (2007). The Production of English Fricatives by the Freshmen of the English Department of FKIP-UKI Jakarta: an Error Analysis. *FKIP-UKI English Department Bimonthly Collegiate Forum* (pp. 1-24). Jakarta: FKIP-UKI.

Phillipson, R. (1993). *Linguistic Imperialism.* Oxford: Oxford University Press.

Prince, A., & Smolensky, P. (1997). "Optimality: From Neural Networks to Universal Grammar". *Science , 274*, 1604-1610.

Roach, P. (1998). *English Phonetics and Phonology: a Practical Course.* Cambridge: Cambridge University Press.

Saraceni, M., & Rubdy, R. (2006). *English in the world: global rules, global roles.* New York: Continuum.

Tiono, & Yostanto. (2008). "A Study of English Phonological Errors Produced by English Department Students". *K@TA Journal* , 79-112.

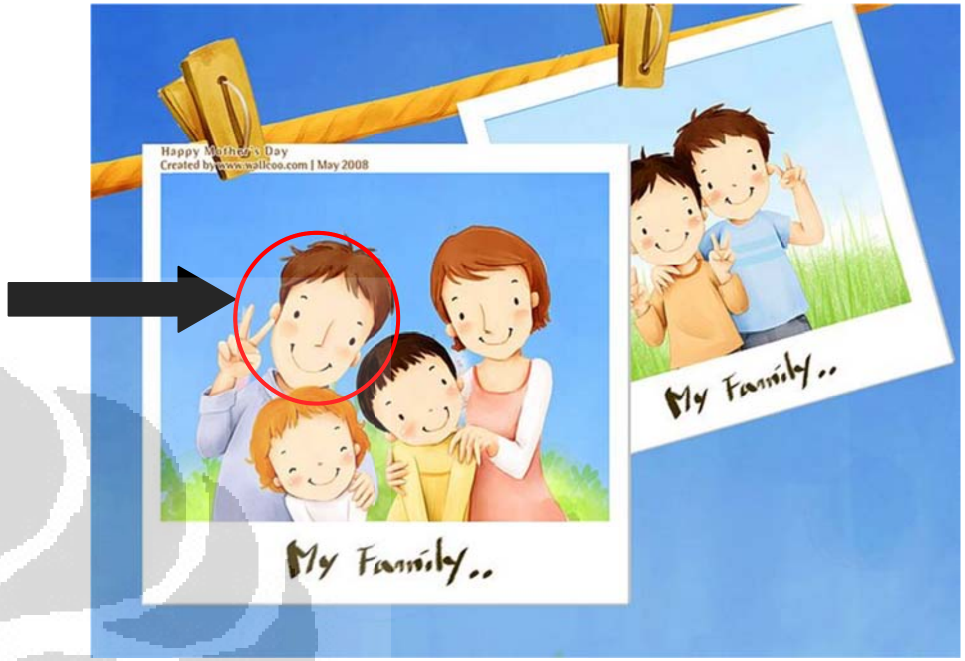
Wells, J. (2000). *Overcoming phonetic interference.* Retrieved May 2011, 25, from http://www.phon.ucl.ac.uk/home/wells/interference.htm

Appendix

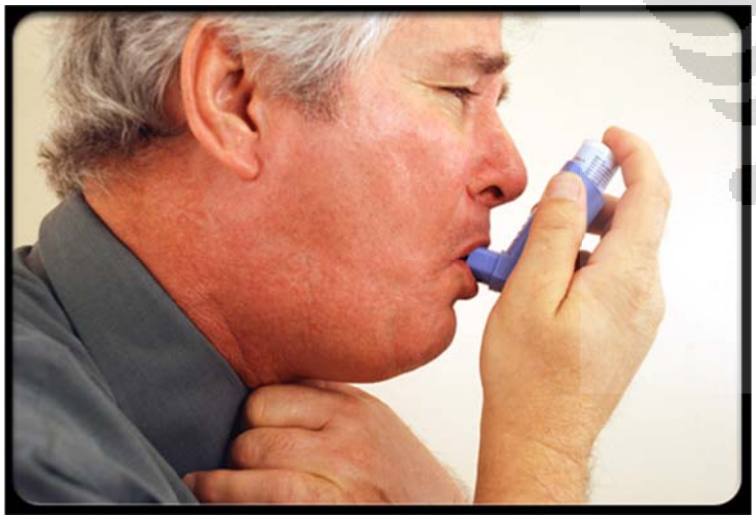
1. **Picture Test**
2. **Word Test**
3. **Sentence Test**
4. **Questionnaire**
5. **Participant Data (Answered Questionnaire)**
6. **SPSS Calculations**

1. Happy ___________!

2. A _______.

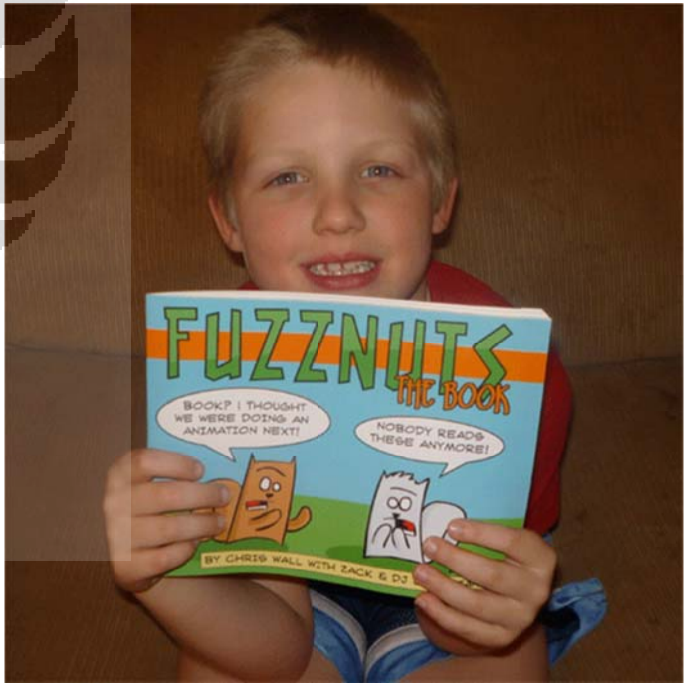


3. The _________ of the family.



4. Hard to _________.

5. Number



6. _________ is my book.

You should bathe because Thursday’s weather is hot. Do the math and stay healthy.

Thanks	There
Athlete	Together
Path	Clothe

1. Usia anda:

   ____

2. Jenis kelamin: L / P

3. Bahasa pertama anda:
   a. Indonesia
   b. Lainnya_____________

4. Bahasa yang paling sering anda gunakan di rumah:
   a. Indonesia
   b. Lainnya____________

5. Telah mempelajari bahasa Inggris selama _______ tahun (termasuk di sekolah)

6. Pernahkah anda tinggal di negara yang bahasa nasionalnya adalah bahasa Inggris (misalnya, Australia, Inggris, Amerika, Kanada, dan Filipina):
   a. Ya, selama _________
   b. Tidak

7. Apakah anda mengalami kesulitan melafalkan bunyi-bunyi bahasa Inggris?
   a. Ya, yaitu ________
   b. Tidak

8. Dimanakah tempat tinggal anda (misalnya, Depok, Jakarta Barat, dst)?

   ____

```
SAVE OUTFILE='C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi
Bernard\Frequency A1-B3.sav'
 /COMPRESSED.
FREQUENCIES VARIABLES=a1 a2 a3 b1 b2 b3
  /BARCHART FREQ
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		30-Dec-2011 01:15:18
Comments		
Input	Data	C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi Bernard\Frequency A1-B3.sav
	Active Dataset	DataSet4
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	45
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=a1 a2 a3 b1 b2 b3 /BARCHART FREQ /ORDER=ANALYSIS.
Resources	Processor Time	00:00:03.500
	Elapsed Time	00:00:05.844

```
[DataSet4] C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi
Bernard\Frequency A1-B3.sav
```

Statistics

		a1	a2	a3	b1	b2	b3
N	Valid	45	45	45	45	45	45
	Missing	0	0	0	0	0	0

Frequency Table

a1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accurate	2	4.4	4.4	4.4
	t	28	62.2	62.2	66.7
	t'	14	31.1	31.1	97.8
	d	1	2.2	2.2	100.0
	Total	45	100.0	100.0	

a2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accurate	4	8.9	8.9	8.9
	t	29	64.4	64.4	73.3
	t'	8	17.8	17.8	91.1
	f	2	4.4	4.4	95.6
	s	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

a3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accurate	1	2.2	2.2	2.2
	t	29	64.4	64.4	66.7
	t'	13	28.9	28.9	95.6
	f	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

b1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accurate	1	2.2	2.2	2.2
	t	1	2.2	2.2	4.4
	d	43	95.6	95.6	100.0
	Total	45	100.0	100.0	

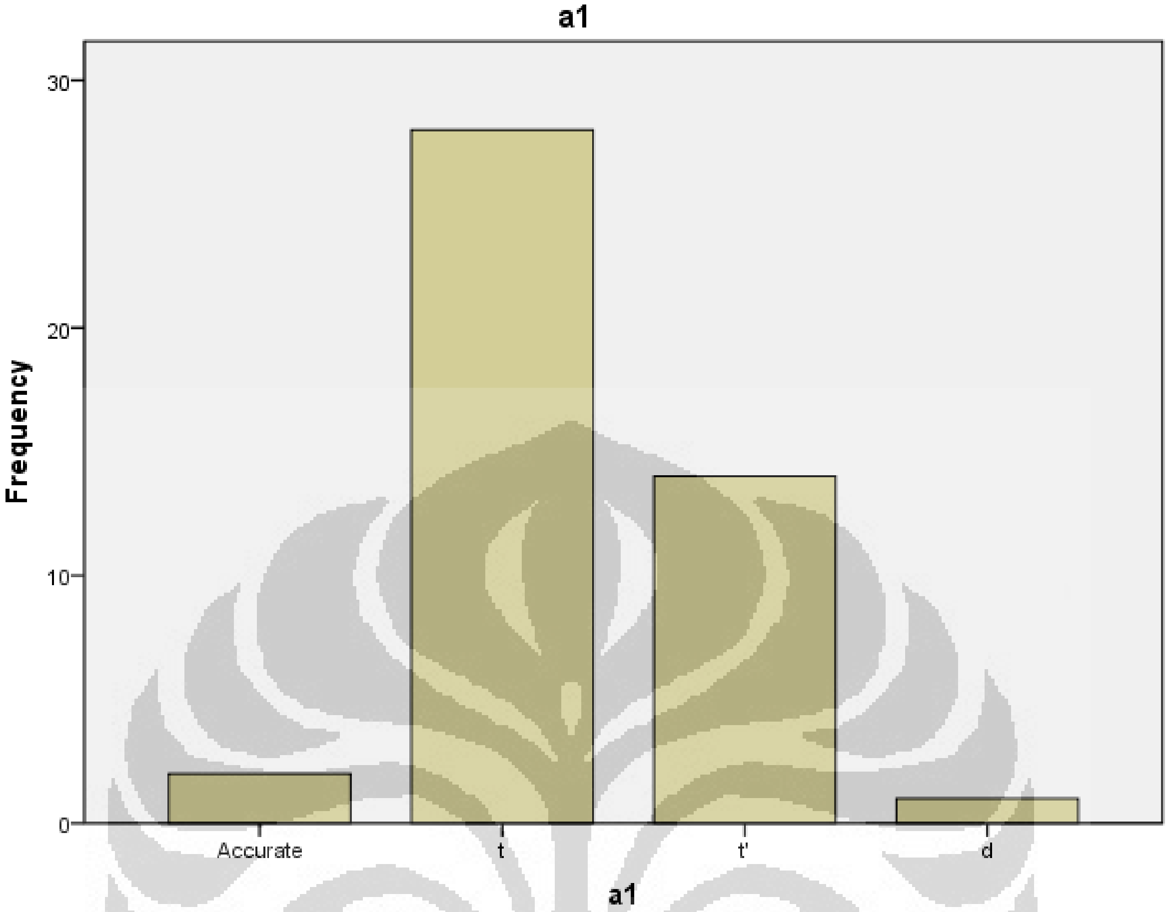
b2

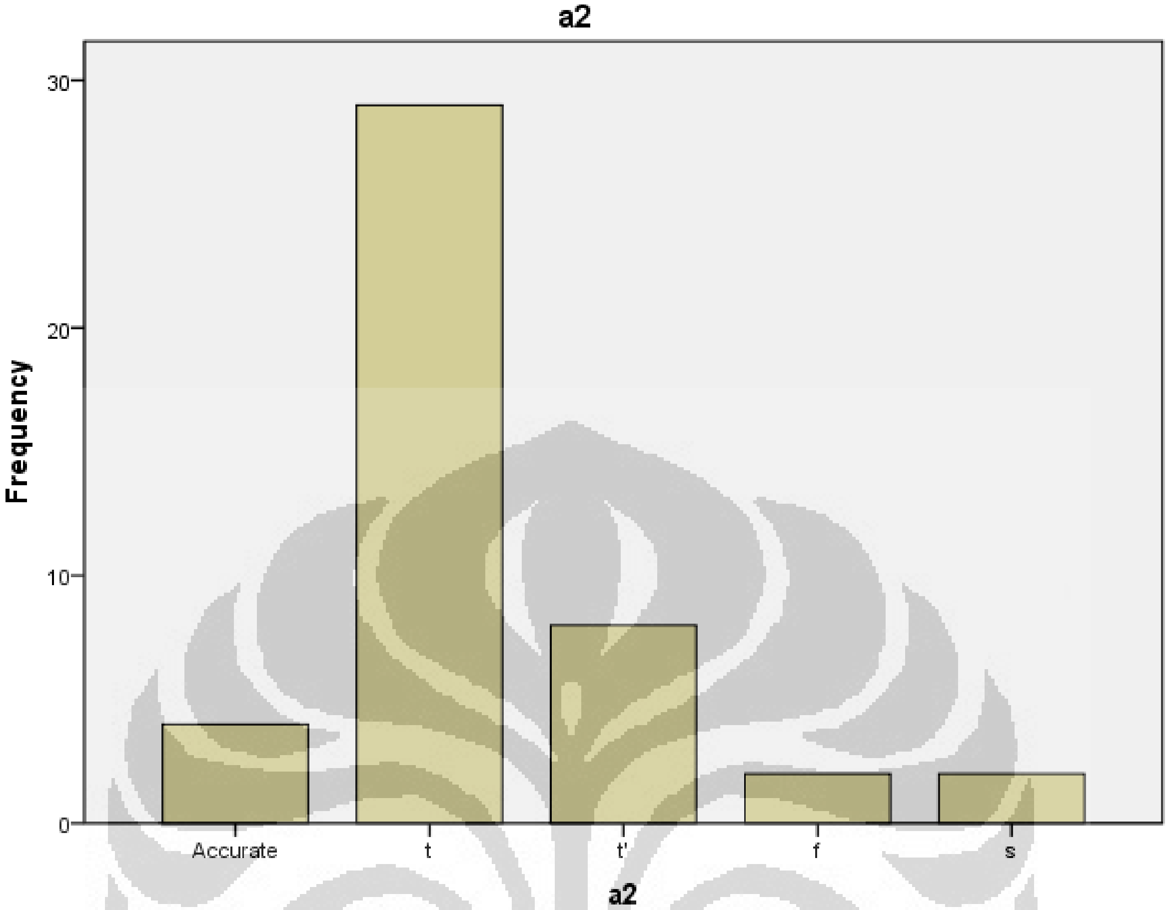
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accurate	2	4.4	4.4	4.4
	t	1	2.2	2.2	6.7
	t'	1	2.2	2.2	8.9
	d	41	91.1	91.1	100.0
	Total	45	100.0	100.0	

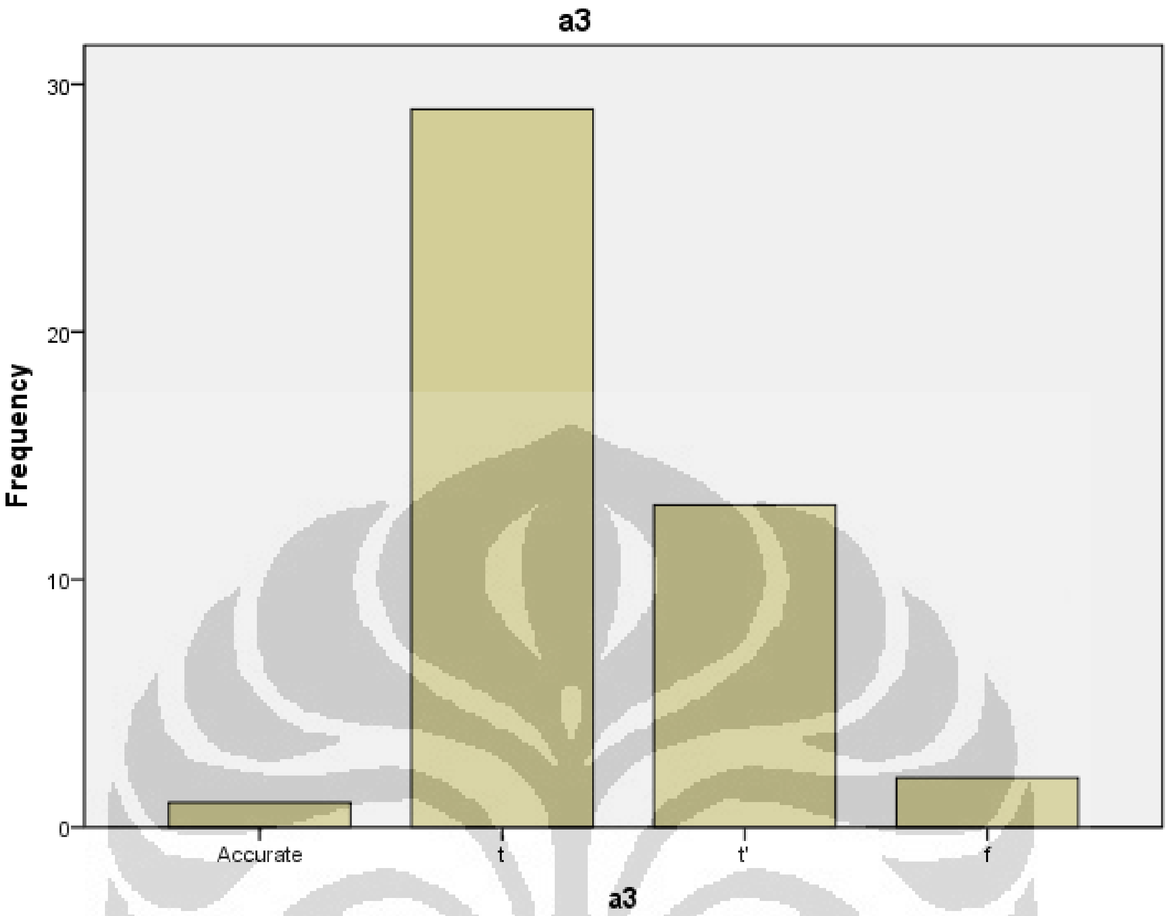
b3

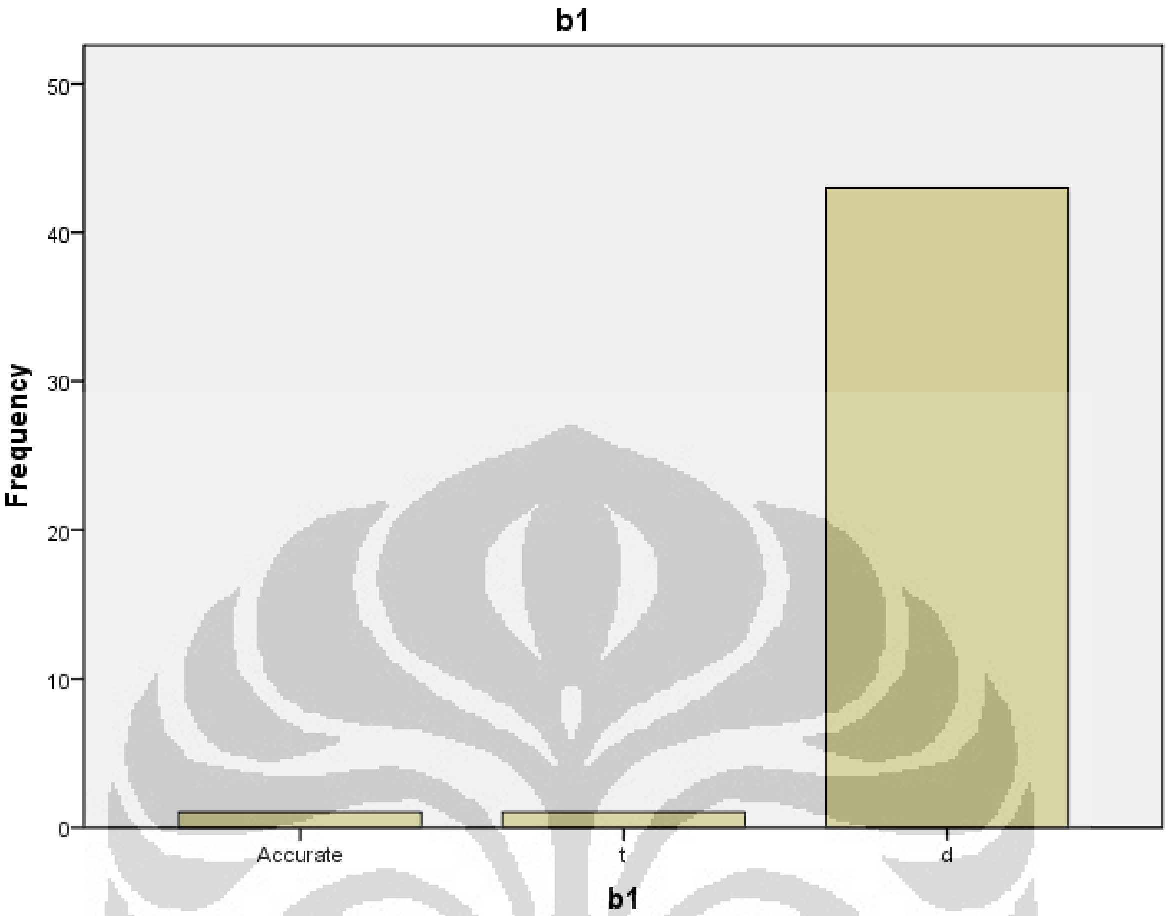
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Accurate	2	4.4	4.4	4.4
	t	24	53.3	53.3	57.8
	t'	17	37.8	37.8	95.6
	f	2	4.4	4.4	100.0
	Total	45	100.0	100.0	

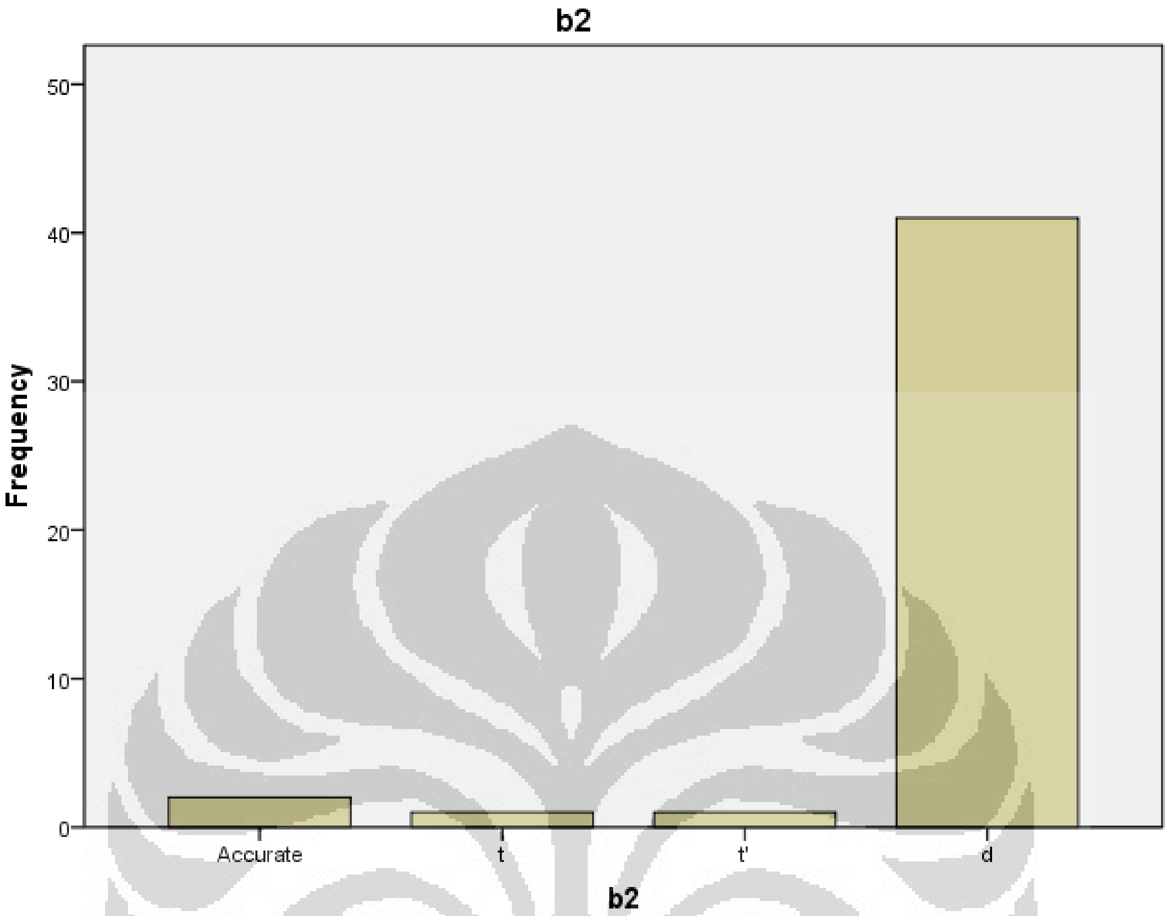
Bar Chart

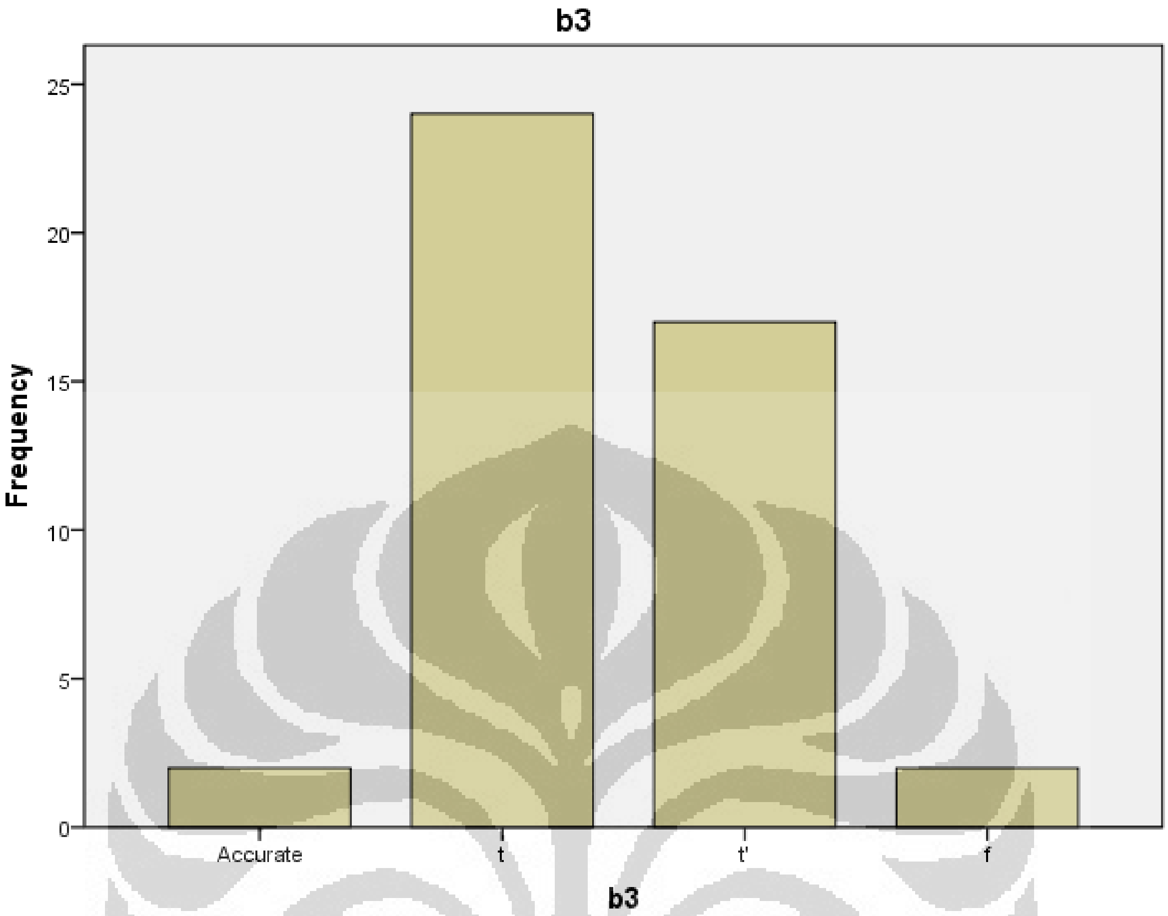

a1
Frequency
30
20
10
0
Accurate
t
t'
d
a1


a2
30
20
10
0
Frequency
Accurate
t
t'
f
s
a2


a3
30
20
10
0
Frequency
Accurate
t
t'
f
a3


b1
50
40
30
20
10
0
Frequency
Accurate
t
d
b1


b2
Frequency
50
40
30
20
10
0
Accurate
t
t'
d
b2


b3
Frequency
25
20
15
10
5
0
Accurate
t
t'
f
b3

```
GLM t tt d f v s z
  /WSFACTOR=Substitusi 7 Polynomial
  /METHOD=SSTYPE(3)
  /EMMEANS=TABLES(OVERALL)
  /EMMEANS=TABLES(Substitusi) COMPARE ADJ(LSD)
  /PRINT=DESCRIPTIVE ETASQ OPOWER
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=Substitusi.
```

General Linear Model

Notes

Output Created		30-Dec-2011 01:50:33
Comments		
Input	Data	C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi Bernard\Repeated Anova A.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	15
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM t tt d f v s z /WSFACTOR=Substitusi 7 Polynomial /METHOD=SSTYPE(3) /EMMEANS=TABLES(OVERALL) /EMMEANS=TABLES(Substitusi) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Substitusi.
Resources	Processor Time	00:00:00.078

Notes

Output Created		30-Dec-2011 01:50:33
Comments		
Input	Data	C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi Bernard\Repeated Anova A.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	15
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM t tt d f v s z /WSFACTOR=Substitusi 7 Polynomial /METHOD=SSTYPE(3) /EMMEANS=TABLES(OVERALL) /EMMEANS=TABLES(Substitusi) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Substitusi.
Resources	Processor Time	00:00:00.078
	Elapsed Time	00:00:00.093

```
[DataSet2] C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi
Bernard\Repeated Anova A.sav
```

Within-Subjects Factors

Measure:MEASURE_1

Substitusi	Dependent Variable
1	t
2	tt

3	d
4	f
5	v
6	s
7	z

Descriptive Statistics

	Mean	Std. Deviation	N
t	5.7333	1.70992	15
tt	2.3333	.97590	15
d	.0667	.25820	15
f	.2667	.59362	15
v	.0000	.00000	15
s	.1333	.35187	15
z	.0000	.00000	15

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.
Substitusi	Pillai's Trace	.997	643.371[a]	5.000	10.000	.000
	Wilks' Lambda	.003	643.371[a]	5.000	10.000	.000
	Hotelling's Trace	321.686	643.371[a]	5.000	10.000	.000
	Roy's Largest Root	321.686	643.371[a]	5.000	10.000	.000

a. Exact statistic

c. Design: Intercept
Within Subjects Design: Substitusi

Multivariate Tests[c]

Effect		Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Substitusi	Pillai's Trace	.997	3216.856	1.000
	Wilks' Lambda	.997	3216.856	1.000
	Hotelling's Trace	.997	3216.856	1.000
	Roy's Largest Root	.997	3216.856	1.000

b. Computed using alpha = .05

c. Design: Intercept
Within Subjects Design: Substitusi

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
_ Substitusi	.000	.	20	.

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

b. Design: Intercept
Within Subjects Design: Substitusi

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Epsilon[a]		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
_ Substitusi	.290	.327	.167

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept
Within Subjects Design: Substitusi

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F
Substitusi	Sphericity Assumed	420.095	6	70.016	99.124
	Greenhouse-Geisser	420.095	1.739	241.534	99.124
	Huynh-Feldt	420.095	1.965	213.817	99.124
	Lower-bound	420.095	1.000	420.095	99.124
Error(Substitusi)	Sphericity Assumed	59.333	84	.706	
	Greenhouse-Geisser	59.333	24.350	2.437	
	Huynh-Feldt	59.333	27.506	2.157	
	Lower-bound	59.333	14.000	4.238	

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F
Substitusi	Sphericity Assumed	420.095	6	70.016	99.124
	Greenhouse-Geisser	420.095	1.739	241.534	99.124
	Huynh-Feldt	420.095	1.965	213.817	99.124
	Lower-bound	420.095	1.000	420.095	99.124
Error(Substitusi)	Sphericity Assumed	59.333	84	.706	
	Greenhouse-Geisser	59.333	24.350	2.437	
	Huynh-Feldt	59.333	27.506	2.157	
	Lower-bound	59.333	14.000	4.238	

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Sig.	Partial Eta Squared	Noncent. Parameter
Substitusi	Sphericity Assumed	.000	.876	594.742
	Greenhouse-Geisser	.000	.876	172.404
	Huynh-Feldt	.000	.876	194.753
	Lower-bound	.000	.876	99.124

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Observed Power[a]
Substitusi	Sphericity Assumed	1.000
	Greenhouse-Geisser	1.000
	Huynh-Feldt	1.000
	Lower-bound	1.000

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	Substitusi	Type III Sum of Squares	df	Mean Square	F	Sig.
	Linear	251.488	1	251.488	283.829	.000

	Quadratic	134.064	1	134.064	98.071	.000
	Cubic	30.044	1	30.044	35.182	.000
	Order 4	.249	1	.249	.349	.564
	Order 5	1.334	1	1.334	4.950	.043
	Order 6	2.915	1	2.915	19.892	.001
	Linear	12.405	14	.886		
	Quadratic	19.138	14	1.367		
	Cubic	11.956	14	.854		
	Order 4	10.010	14	.715		
	Order 5	3.773	14	.270		
	Order 6	2.052	14	.147		

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	Substitusi	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
	Linear	.953	283.829	1.000
	Quadratic	.875	98.071	1.000
	Cubic	.715	35.182	1.000
	Order 4	.024	.349	.085
	Order 5	.261	4.950	.544
	Order 6	.587	19.892	.985

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	156.038	1	156.038	862.316	.000	.984
Error	2.533	14	.181			

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Noncent. Parameter	Observed Power[a]
Intercept	862.316	1.000

a. Computed using alpha = .05

Estimated Marginal Means

1. Grand Mean

Measure:MEASURE_1

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
1.219	.042	1.130	1.308

2. Substitusi

Estimates

Measure:MEASURE_1

Substitusi	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	5.733	.441	4.786	6.680

2	2.333	.252	1.793	2.874
3	.067	.067	-.076	.210
4	.267	.153	-.062	.595
5	.000	.000	.000	.000
6	.133	.091	-.062	.328
7	.000	.000	.000	.000

Pairwise Comparisons

Measure:MEASURE_1

(I) Substitusi	(J) Substitusi	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	3.400*	.559	.000	2.201	4.599
	3	5.667*	.475	.000	4.648	6.685
	4	5.467*	.559	.000	4.267	6.667
	5	5.733*	.441	.000	4.786	6.680
	6	5.600*	.456	.000	4.623	6.577
	7	5.733*	.441	.000	4.786	6.680
2	1	-3.400*	.559	.000	-4.599	-2.201
	3	2.267*	.267	.000	1.695	2.839
	4	2.067*	.345	.000	1.328	2.806
	5	2.333*	.252	.000	1.793	2.874
	6	2.200*	.262	.000	1.638	2.762
	7	2.333*	.252	.000	1.793	2.874
3	1	-5.667*	.475	.000	-6.685	-4.648
	2	-2.267*	.267	.000	-2.839	-1.695
	4	-.200	.145	.189	-.510	.110
	5	.067	.067	.334	-.076	.210
	6	-.067	.118	.582	-.320	.187
	7	.067	.067	.334	-.076	.210
4	1	-5.467*	.559	.000	-6.667	-4.267
	2	-2.067*	.345	.000	-2.806	-1.328
	3	.200	.145	.189	-.110	.510
	5	.267	.153	.104	-.062	.595
	6	.133	.192	.499	-.278	.545
	7	.267	.153	.104	-.062	.595
5	1	-5.733*	.441	.000	-6.680	-4.786

	2	-2.333*	.252	.000	-2.874	-1.793
	3	-.067	.067	.334	-.210	.076
	4	-.267	.153	.104	-.595	.062
	6	-.133	.091	.164	-.328	.062
	7	.000	.000	.	.000	.000
6	1	-5.600*	.456	.000	-6.577	-4.623
	2	-2.200*	.262	.000	-2.762	-1.638
	3	.067	.118	.582	-.187	.320
	4	-.133	.192	.499	-.545	.278
	5	.133	.091	.164	-.062	.328
	7	.133	.091	.164	-.062	.328
7	1	-5.733*	.441	.000	-6.680	-4.786
	2	-2.333*	.252	.000	-2.874	-1.793
	3	-.067	.067	.334	-.210	.076
	4	-.267	.153	.104	-.595	.062
	5	.000	.000	.	.000	.000
	6	-.133	.091	.164	-.328	.062

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.997	643.371[a]	5.000	10.000	.000	.997
Wilks' lambda	.003	643.371[a]	5.000	10.000	.000	.997
Hotelling's trace	321.686	643.371[a]	5.000	10.000	.000	.997
Roy's largest root	321.686	643.371[a]	5.000	10.000	.000	.997

Each F tests the multivariate effect of Substitusi. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

Multivariate Tests

	Noncent. Parameter	Observed Power[b]
Pillai's trace	3216.856	1.000
Wilks' lambda	3216.856	1.000
Hotelling's trace	3216.856	1.000

Roy's largest root	3216.856	1.000

Each F tests the multivariate effect of Substitusi. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

b. Computed using alpha = .05

```
GLM t tt d f v s z
  /WSFACTOR=Substitusi 7 Polynomial
  /METHOD=SSTYPE(3)
  /EMMEANS=TABLES(OVERALL)
  /EMMEANS=TABLES(Substitusi) COMPARE ADJ(LSD)
  /PRINT=DESCRIPTIVE ETASQ OPOWER
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=Substitusi.
```

General Linear Model

Notes

Output Created		30-Dec-2011 01:56:35
Comments		
Input	Data	C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi Bernard\Repeated Anova B.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	15
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM t tt d f v s z /WSFACTOR=Substitusi 7 Polynomial /METHOD=SSTYPE(3) /EMMEANS=TABLES(OVERALL) /EMMEANS=TABLES(Substitusi) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Substitusi.
Resources	Processor Time	00:00:00.047

Notes

Output Created		30-Dec-2011 01:56:35
Comments		
Input	Data	C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi Bernard\Repeated Anova B.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	15
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM t tt d f v s z /WSFACTOR=Substitusi 7 Polynomial /METHOD=SSTYPE(3) /EMMEANS=TABLES(OVERALL) /EMMEANS=TABLES(Substitusi) COMPARE ADJ(LSD) /PRINT=DESCRIPTIVE ETASQ OPOWER /CRITERIA=ALPHA(.05) /WSDESIGN=Substitusi.
Resources	Processor Time	00:00:00.047
	Elapsed Time	00:00:00.079

```
[DataSet2] C:\Documents and Settings\Tjibeng Jap\Desktop\Skripsi
Bernard\Repeated Anova B.sav
```

Within-Subjects Factors

Measure:MEASURE_1

Substitusi	Dependent Variable
1	t
2	tt
3	d
4	f
5	v
6	s
7	z

Descriptive Statistics

	Mean	Std. Deviation	N
t	1.7333	1.16292	15
tt	1.2000	.86189	15
d	5.6000	.82808	15
f	.1333	.35187	15
v	.0000	.00000	15
s	.0000	.00000	15
z	.0000	.00000	15

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.
Substitusi	Pillai's Trace	.982	146.007[a]	4.000	11.000	.000
	Wilks' Lambda	.018	146.007[a]	4.000	11.000	.000
	Hotelling's Trace	53.093	146.007[a]	4.000	11.000	.000
	Roy's Largest Root	53.093	146.007[a]	4.000	11.000	.000

a. Exact statistic

c. Design: Intercept
Within Subjects Design: Substitusi

Multivariate Tests[c]

Effect		Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Substitusi	Pillai's Trace	.982	584.027	1.000
	Wilks' Lambda	.982	584.027	1.000
	Hotelling's Trace	.982	584.027	1.000
	Roy's Largest Root	.982	584.027	1.000

b. Computed using alpha = .05

c. Design: Intercept
Within Subjects Design: Substitusi

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
Substitusi	.000	.	20	.

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

b. Design: Intercept
Within Subjects Design: Substitusi

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Epsilon[a]		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Substitusi	.321	.371	.167

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept
Within Subjects Design: Substitusi

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F
Substitusi	Sphericity Assumed	376.381	6	62.730	141.143
	Greenhouse-Geisser	376.381	1.926	195.385	141.143
	Huynh-Feldt	376.381	2.228	168.962	141.143
	Lower-bound	376.381	1.000	376.381	141.143
Error(Substitusi)	Sphericity Assumed	37.333	84	.444	
	Greenhouse-Geisser	37.333	26.969	1.384	
	Huynh-Feldt	37.333	31.187	1.197	
	Lower-bound	37.333	14.000	2.667	

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Sig.	Partial Eta Squared	Noncent. Parameter
Substitusi	Sphericity Assumed	.000	.910	846.857
	Greenhouse-Geisser	.000	.910	271.892
	Huynh-Feldt	.000	.910	314.411
	Lower-bound	.000	.910	141.143

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Observed Power[a]
Substitusi	Sphericity Assumed	1.000
	Greenhouse-Geisser	1.000
	Huynh-Feldt	1.000
	Lower-bound	1.000

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	Substitusi	Type III Sum of Squares	df	Mean Square	F	Sig.
	Linear	93.343	1	93.343	325.537	.000

	Quadratic	13.413	1	13.413	25.305	.000
	Cubic	64.178	1	64.178	91.475	.000
	Order 4	.997	1	.997	1.850	.195
	Order 5	111.013	1	111.013	276.045	.000
	Order 6	93.438	1	93.438	451.392	.000
	Linear	4.014	14	.287		
	Quadratic	7.421	14	.530		
	Cubic	9.822	14	.702		
	Order 4	7.548	14	.539		
	Order 5	5.630	14	.402		
	Order 6	2.898	14	.207		

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	Substitusi	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
	Linear	.959	325.537	1.000
	Quadratic	.644	25.305	.997
	Cubic	.867	91.475	1.000
	Order 4	.117	1.850	.245
	Order 5	.952	276.045	1.000
	Order 6	.970	451.392	1.000

a. Computed using alpha = .05

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	160.952	1	160.952	676.000	.000	.980
Error	3.333	14	.238			

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Noncent. Parameter	Observed Power[a]
Intercept	676.000	1.000

a. Computed using alpha = .05

Estimated Marginal Means

1. Grand Mean

Measure:MEASURE_1

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
1.238	.048	1.136	1.340

2. Substitusi

Estimates

Measure:MEASURE_1

Substitusi	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	1.733	.300	1.089	2.377
2	1.200	.223	.723	1.677
3	5.600	.214	5.141	6.059
4	.133	.091	-.062	.328
5	.000	.000	.000	.000
6	.000	.000	.000	.000
7	.000	.000	.000	.000

Pairwise Comparisons

Measure:MEASURE_1

(I) Substitusi	(J) Substitusi	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	.533	.487	.292	-.510	1.577
	3	-3.867*	.350	.000	-4.617	-3.116
	4	1.600*	.335	.000	.881	2.319
	5	1.733*	.300	.000	1.089	2.377
	6	1.733*	.300	.000	1.089	2.377
	7	1.733*	.300	.000	1.089	2.377
2	1	-.533	.487	.292	-1.577	.510
	3	-4.400*	.289	.000	-5.021	-3.779
	4	1.067*	.248	.001	.534	1.599
	5	1.200*	.223	.000	.723	1.677
	6	1.200*	.223	.000	.723	1.677
	7	1.200*	.223	.000	.723	1.677
3	1	3.867*	.350	.000	3.116	4.617
	2	4.400*	.289	.000	3.779	5.021
	4	5.467*	.215	.000	5.005	5.928
	5	5.600*	.214	.000	5.141	6.059
	6	5.600*	.214	.000	5.141	6.059

	7	5.600*	.214	.000	5.141	6.059
4	1	-1.600*	.335	.000	-2.319	-.881
	2	-1.067*	.248	.001	-1.599	-.534
	3	-5.467*	.215	.000	-5.928	-5.005
	5	.133	.091	.164	-.062	.328
	6	.133	.091	.164	-.062	.328
	7	.133	.091	.164	-.062	.328
5	1	-1.733*	.300	.000	-2.377	-1.089
	2	-1.200*	.223	.000	-1.677	-.723
	3	-5.600*	.214	.000	-6.059	-5.141
	4	-.133	.091	.164	-.328	.062
	6	.000	.000	.	.000	.000
	7	.000	.000	.	.000	.000
6	1	-1.733*	.300	.000	-2.377	-1.089
	2	-1.200*	.223	.000	-1.677	-.723
	3	-5.600*	.214	.000	-6.059	-5.141
	4	-.133	.091	.164	-.328	.062
	5	.000	.000	.	.000	.000
	7	.000	.000	.	.000	.000
7	1	-1.733*	.300	.000	-2.377	-1.089
	2	-1.200*	.223	.000	-1.677	-.723
	3	-5.600*	.214	.000	-6.059	-5.141
	4	-.133	.091	.164	-.328	.062
	5	.000	.000	.	.000	.000
	6	.000	.000	.	.000	.000

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the .05 level.

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.982	146.007[a]	4.000	11.000	.000	.982
Wilks' lambda	.018	146.007[a]	4.000	11.000	.000	.982
Hotelling's trace	53.093	146.007[a]	4.000	11.000	.000	.982
Roy's largest root	53.093	146.007[a]	4.000	11.000	.000	.982

Each F tests the multivariate effect of Substitusi. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

Multivariate Tests

	Noncent. Parameter	Observed Power[b]
Pillai's trace	584.027	1.000
Wilks' lambda	584.027	1.000
Hotelling's trace	584.027	1.000
Roy's largest root	584.027	1.000

Each F tests the multivariate effect of Substitusi. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

b. Computed using alpha = .05