Language deficits: Comparing the phonological misproductions of three Aphasia types to support whether patterns in phonological misproductions are governed by the Aphasia type or are specific to the individual patient

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Abstract

Current research into Aphasia suggest that the language deficit is in no way homogenous (National Aphasia Association, 2016). However, it is suggested by the categorisation of Aphasia types that certain language traits are characterised by the type of Aphasia afflicted on a person. This study looks at the production of Aphasic Language from twelve patients, of three different Aphasia types (Broca's, Anomic and Wernicke's), in an attempt to find whether types of phonological misproductions are characterised by the type of Aphasia. This is achieved through a more descriptive approach to the study of phonological processes. The method includes collecting misproductions from Speech and Language Pathology sessions, obtained from the online database AphasiaBank, of all twelve patients (MacWhinney et al, 2011)*. The misproductions are then compared with target productions acquired from the Oxford English Dictionary. The types of misproductions are categorised (vowel change, substitution, assimilation and syllable structure) and are made into a percentage out of the total misproductions made by an individual patient. From this, the study is able to show whether patterns between Aphasia type and misproduction type occur.*

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1. Introduction

1.1. Dissertation Overview

This study makes use of a descriptive approach to the phonological[1] misproductions of three Aphasia types (Broca's, Anomic and Wernicke's). It studies the language use of twelve different Aphasia patients, four of each aphasia type, in order to discover whether the types of phonological misproductions made by aphasia patients show correlation with the type of aphasia.

Access to Aphasic language is granted by the online database AphasiaBank (MacWhinney et al, 2011). From this I am able to access therapy sessions between the Patients and Speech and Language Pathologists. Any misproduced words that appear in the sessions is taken note of and compared to a target pronunciation provided by the Oxford English Dictionary. The misproductions are then labelled and a total percentage of which type of misproduction occurs the most in individuals, out of the entire amount of misproductions, is collated. The percentages of misproduction types are then compared between patients to see if patterns between misproduction types and aphasia types have emerged.

1.2. Motivations for the Study

Research into the phonological aspects of language deficits is ongoing (Murdoch, 2010; MacWhinney, Fromm, Forbes & Holland, 2011). However, the method usually applied to studying misproductions often makes use of the concept of phonological processes (Miller, Ellis & Sin, 1983; Coltheart, Sartori & Job, 2013:256). Where this study differs is that it will

[1] The study of sound patterns in language (MacMahon, 2002).

attempt to describe what is misproduced in the word, be it an already accredited phonological process or not, to attempt to more accurately suggest what is occurring in the Aphasic language. This dissertation also hopes to further the research into language deficits and to provide an answer to whether there is a relationship between Aphasia types and misproduction types.

A final motive of this research is the prospect of studying speech and language pathology. This is an aim of mine and through studying linguistics I feel able to apply descriptive methods of language study to those affected by language deficits.

2. Literature review

This section will review some of the existing literature surrounding research into aphasia, phonology and methods dealing with phonology in aphasia. More comprehensively, the section will serve to clearly define the main aspects of what will be dealt with in the following study and discuss why the three aphasia types used in this study were chosen. It shall also review other scholarly articles, in which similar methods have been used, to be able to discuss the strengths and weaknesses of methods applied to aphasia research.

2.1. Aphasia

Aphasia, in the simplest terms, is a language deficit that is acquired after a brain injury (Obler & Gjerlow, 1999:1).

An immediate problem with defining aphasia is that it is in no way homogeneous therefore cannot be specifically defined only grouped. Although, even grouping raises issues due to different researchers being in disagreement to how aphasia should be categorised.

The National Aphasia Association (NAA) list seven categories which take into account the linguistic tools affected and the severity (NAA, 2016). This source should be reliable due to the prominence of both the website and the researchers who have worked on it. However, it appears that the website is made for the general user wanting to understand, in a basic overview, what aphasia is. This claim is supported by information on the NAA's mission statement which is featured on their website. It mentions that the mission of the National Aphasia Association is to promote public awareness and understanding of aphasia so that people affected by the language deficit may be provided with support (NAA, 2016). This

implies that information on the website may not necessarily be in-depth. Instead, it suggests that the information is provided for anybody with or without any knowledge of aphasia.

A more scientific approach to the categorization of aphasia suggests that there may be seven, eight or twelve categories (Murdoch, 2010:54-69). However, Murdoch's classification system raises more issues as many of these categories are not even relative, in symptoms, to the categories suggested by the NAA.

Dressler and Stark (1988), introduce the concept of the 'classic' categories of which there are four – Broca's, Global, Wernicke's and anomic (Dressler & Stark, 1988:40). The advantages of using this classification system are that it is concise and covers many of the symptoms mentioned by newer research in a more general way. However, looking at the types of aphasia from a general perspective could be perceived as a disadvantage. Firstly, the majority of aphasia research presented in the last decade does not conform to the classic classification system (Murdoch, 2010; MacWhinney et al 2011). This indicates that research has moved on from this perspective and is heading towards a more specified view of aphasia. Secondly, Dressler and Stark's (1988) research was conducted almost three decades ago (Dressler & Stark, 1988). In this time research has been ongoing. The reviewing of literature since Dressler & Stark's publication has caused changes in the way that specialists deal with aphasia and how clinical treatments are structured (Beeson & Robey, 2006). An example of an inaccuracy that would be caused by using Dressler and Starks's classification system is the loss of some characteristics to the aphasia types that they propose. This is due to more aphasia types now existing therefore separating characteristics previously grouped under one aphasia type. Thus using Dressler and Stark's classification system could cause inaccuracies in the current study (Dressler & Stark, 1988).

It was due to the difficulties in classification that the decision was made to focus on only three aphasia types. This is common amongst aphasia research where often researchers will focus on only one of the aphasia types to gain better understanding of it characteristics (Blumstein, Baker and Goodglass, 1977; Laganaro and Zimmermann, 2010). However, as this dissertation is a comparative study it will need multiple aphasia types. Therefore I selected three aphasia types on the basis of three premises:

Firstly, how clearly defined and agreed upon are the characteristics of the aphasia type in previous literature?

Secondly, am I able to get access to examples of the aphasia type in the AphasiaBank database?

Thirdly, are patients of this aphasia type known to make misproductions in speech?

The following subsections will present the aphasia types used in this study. The sections will also include the characteristics and definitions of the aphasia type as well as the reasons why the aphasia type was chosen for this study.

2.1.1. Broca's Aphasia

Broca's aphasia, or expressive aphasia, groups speakers who find producing language to be effortful yet maintain, to a relatively good extent, their comprehensive skills (Larner, 2001:65). The linguistic level in which speakers are affected tends to be grammatical, therefore causing the inability to produce well-formed syntactic sentences and inflect verbs correctly for tense (Grodzinksky & Amunts, 2006; Friedmann, 2001:6). However, evidence

from the AphasiaBank database does show that the more general errors in sound production do occur.

Language use of Broca's aphasia speakers usually consists of utterances of fewer than four words, repetition and long pauses along with being mainly telegrammatic (their language features predominantly nouns and action verbs) (Murdoch, 2010:57). This can, however, dependent on the severity of the aphasia and how far along the rehabilitation process the patient is (Beeson & Robey, 2006).

The reasons for using this aphasia type are was first written about in 1861 (Broca, 1861). Though there has been a lot of change in the defining of its characteristics since then, there is a vast amount of available literature on this aphasia type. It is also accessible on the database that shall be used for this study. Hence, making this aphasia type ideal for study in this dissertation.

2.1.2. Wernicke's Aphasia

Similarly to Broca's, Wernicke's aphasia mainly affects the production of language. Comprehension may also be affected however this differs among patients (Blumstein, Baker & Goodglass, 1977:20-22). Wernicke's aphasia was also written about around the same time as Broca's aphasia making research on this aphasia type equally as common (Wernicke, 1874). The difference in symptoms is that Wernicke's patients often use words in inappropriate contexts, produce words incorrectly with incorrect language sounds in them or completely omit language sounds from words (Pulvermuller, 2002:34; Holland, 2008). It has also been suggested that speakers may also omit certain types of words particularly

with a relative lack of nouns, adjectives and main verbs with substitutions of grammatical morphemes (Ahlsen, 2006:68).

The nature of this aphasia-type, in particular the substitution or omission of sounds, are highly relevant for this research. This aphasia type is also accessible on the database.

2.1.3. Anomic Aphasia

The final category, used in this research, is anomic aphasia. This aphasia type is described by the NAA as a milder form of the language deficit (NAA). Although all patients are affected differently and the severity is often variable (Beeson & Robey, 2006). The prominent feature of this aphasia-type is a person's word-finding ability. For example, a person affected by anomic aphasia will have difficulty thinking of the correct word for something (Benson & Ardilla, 1996:163). Contrary to the previous two aphasia types, language comprehension varies in anomic aphasia (Benson & Ardilla, 1996:163). This means that patients of anomic aphasia do not only struggle to produce language but also struggle to understand it.

Anomic aphasia is also accessible on the AphasiaBank database, making it available for this project. From analysis of this aphasia type in the database, I am able to add that anomic aphasia patients can be known to produce incorrect sounds in words. Although this aphasia type has not been written about for as long as Broca's and Wernicke's, there is clear and accessible literature available. Despite all aphasia types being well covered by literature, preference for anomic aphasia was due to finding studies in which anomic aphasia was compared to both Broca's and Wernicke's (Khon & Goodglass, 1985; Bastiaanse & Jonkers, 1998).

2.2. Phonology

Phonological processes describe the way in which speech is simplified by an individual. Due to speech being a physical process, the sound patterns of language are governed by constraints of human production mechanisms (Stampe, 1979). A feature of language that must be explained, in order to properly understand what is meant by a phonological process, is the concept of phonological oppositions. These are best explained by examples of minimal pairs. Minimal pairs are sets of words that that differ phonetically but only in one way (Jeffries, 2006:47). An example of this in English would be:

Pot, tot, cot, hot

These words all differ in each of the word's initial consonants. This proves /p/, /t/, /k/ and /h/ are phonemes in English as the correct production of each is needed for the hearer to understand the word's semantic content (Jeffries, 2006:47). The phonological opposition in this case are the individual phonemes /p/, /t/, /k/ and /h/.

Phonological processes merge phonological oppositions that put the least strain on a human's speech ability (Ball, 2011:412). Referring back to the previous examples, a phonological process would be where a speaker uses 'pot' when actually meaning 'cot'.

The reason that this dissertation uses 'phonological misproductions' rather than 'phonological processes' is because of the confusion with the theory of natural phonological processes (Donegan & Stampe, 1979). This theory focuses on what is considered physiologically easier in speech production. The concept of natural phonological processes are usually associated with the linguistic discipline of child language acquisition. This is because the most useful datatype to support which sounds are considered easy to produce

is child speech (Donegan & Stampe, 1979). The difference between Donegan and Stampe's study and the present study is that this study shall look at all the phonological misproductions produced by the aphasia patients. Aphasia is caused by problems regarding neurology. Hence, the patient may not necessarily misproduce speech sounds based on what is physiologically difficult. Phonological processes that are not based on physiological ease are known as deviant processes (Ball, 2011:413).

This dissertation applies a more descriptive method to studying misproductions in aphasic speech. Therefore, when applicable, this study shall cover natural phonological processes and deviant processes. In the case that no previously accredited process is available, the misproduction will be described accordingly.

2.3 Methodologies when analysing phonology in language deficits

Fortunately, research into phonology in language deficits is not sparse.

Blumstein, Baker and Goodglass (1977) look at the comprehension deficit of Wernicke's aphasiacs. The study aims to discover whether the deficit can be attributed to phonemic hearing or phonemic discrimination (Blumstein, Baker & Goodglass, 1977). Phonemic discrimination is the differentiation of acoustically similar sounds whereas phonemic hearing is the ability to both hear and process the sounds in speech (Yopp, 1992; Freitas, Mezzomo & Vidor, 2015:1). Their method took 25 patients of different aphasia-types and tested their ability to comprehend differences in minimal pairs (Blumstein, Baker and Goodglass, 1977:20). Minimal pairs are sets of words that that differ phonetically but only in one way (Jeffries, 2006:47). Though this dissertation focuses on production, the concept of

minimal pairs is still highly relevant to the study. This will be discussed in more detail throughout the present study.

A more recent study tests the production of phonemic errors in aphasia patients by using a target system (Coltheart, Sartori & Job, 2013:256). The method here used a picture-naming experiment whereby the speaker would name the object. Often the speaker would unintentionally produce a paraphasia, or neologism, which was matched against the target word[2] (Coltheart, Sartori & Job, 2013:256). The same type of task is available in the AphasiaBank database. The use of a target word is one that will be applied to this dissertation. This is because the present study will make use of categorising the types of phonological errors in a word. For this to be effective a target pronounced form must be available in order to make the judgement of what has gone wrong in the pronunciation.

Laganaro and Zimmermann (2010), question the origins of phonological errors of conduction aphasia (Laganaro and Zimmermann, 2010). Although the origins do not have much relevance to the present study, the way that the researchers collect data is. Their task, again, made use of picture naming in order to note problems in production. The study differs from the previous by splitting these naming tasks into subgroups based of syllables (monosyllabic, disyllabic and trisyllabic). This study also made use of a corpora whereby all the paraphasias were entered (Laganaro and Zimmermann, 2010). Because the present study deals with less data that Laganaro and Zimmermann's study the use of corpus-assistance will not be required. Despite this, this study will make use of a corpus-like method whereby all the data will be noted and presented in order to form an answer to the research question.

[2] The pronunciation that the participant will be aiming for.

2.4 Summary of findings

To summarise, this study will make use of three aphasia types. This is because, firstly, it is common in aphasia research to select a few of the types to make a comparison (Blumstein, Baker and Goodglass, 1977; Laganaro and Zimmermann, 2010). Also, to attempt to study all of the aphasia types, available in the database, could perhaps create the possibility of not applying enough focus. Therefore the most ideal aphasia types for this study were chosen (Broca's, Anomic and Wernicke's).

The study will also make use of target words as a form of comparison to what the patient was attempting to achieve in terms of pronunciation.

3. Aims and Hypothesis

The primary aim of this dissertation is to compare the phonological misproductions of the three aphasia-types to support whether patterns in phonological misproductions are governed by the aphasia-type or are specific to the individual patient.

Put simply, this research shall examine the phonological misproductions of twelve different patients who fall into three classifications of aphasia (Broca's, Anomic and Wernicke's). By doing this, the research will be able to show correlations between the individual patients of the same aphasia type and correlations of patients of different aphasia types. This may show that certain types of phonological misproductions are more common amongst one specific classification of aphasia. For example, Wernicke's aphasia patients use more substitutions than all the other aphasia types. Alternatively, it could show that there are no correlations between misproduction and classifications of aphasia types.

I hypothesise that although commonalities may occur amongst some patients of the same aphasia types the results will most likely show that aphasia types do not govern the types of phonological misproductions made. This hypothesis is based on the information that is provided by the National Aphasia Association which states that aphasia is in no way homogenous (NAA, 2016).

4. Data

The data used in this dissertation was provided by AphasiaBank. This chapter will cover what AphasiaBank is and the prominence that it has in aphasia research. It will also discuss the patients that were selected for the present study and mention any affecting factors that using these patients could have on this research. Finally, it will discuss the procedure of the sessions from which the data was extracted from.

Before going into detail, it should be made clear that the actual data that is analysed in this study is the individual word that is clearly mispronounced by participants. These are referred to as tokens. What is meant by 'clearly mispronounced' is that there is an available target word for the misproduction.

4.1. AphasiaBank

AphasiaBank is a shared database of interactions for the study of communication in aphasia compiled by multiple scholars (MacWhinney et al, 2011). The aim of the database is to capture the behaviours of aphasic language so that it may be studied in order for aphasia research to progress. The website itself contains a bibliography of the work done using the database. The research done using AphasiaBank varies from studies at the lower levels of language, like the present study, to studies looking at the higher levels such as discoursal features (Boyle, 2016).

In 2011 there were 157 different subjects in the database taken from 12 different collection sites throughout the United States (Jackson et al, 2011). Each video comes with a transcript that transcribes the data at different levels of language. For example, the database can

show what is being said and include information on the grammaticality of each of the words (Jackson et al, 2011).

The present study looks at the phonological level of language. Therefore the most useful tool that AphasiaBank presents, in this case, is the IPA transcription that follows misproduced words. AphasiaBank also presents a target word that the transcribers intuit that the patient intended to produce (MacWhinney et al, 2011). The provided target words will be what is used to decide the intended production in this study. However, often the sessions are not fully transcribed. Despite this, the majority of the misproductions that are collected post transcribed data are produced in picture naming tasks where the materials used are available. Therefore it is relatively easy to decipher the target productions.

4.2. Participants

This study uses the full sessions of twelve participants. Each participant is an aphasia patient. Eleven of the patients acquired aphasia due to a stroke and one due to encephalitis.

The process of selecting which patients to use in the study was based on the premises of variation. The most important factor in the selection of patients was that each aphasia type studied had an equal number of patients. Therefore the study uses four patients of each, Broca's, Anomic and Wernicke's Aphasias. Of each of the four patients two are male and two are female. This is because research has suggested that sex difference is an affecting factor in the severity of aphasia (Sundet, 1988). Sex therefore must be accounted for in this study.

It was intended that different severities of the aphasia types would to be varied. This, however, is difficult to judge due to the question: How is the severity of a language disorder classified? In normal circumstances the severity of aphasia is judged on how many of the aspects of speech and language have been affected (reading, writing, understanding and speaking) (Bartels, 2013). As this study focuses on only the speech production aspect of language this variation cannot be applied.

To make the deliverance of the present study as simplistic as possible each Patient was alphabetically coded. All of the files for the patients were taken from the AphasiaBank browsable database and are located in (/Aphasia/English/Aphasia/). The study makes use of six of the AphasiaBank collection points. One session was used for each patient. The location of the sessions and the code of each Patient used in this study are as collected in the table below.

Patient code	*Location in database*	*Aphasia type*	*Sex*
Patient A	Wright/Wright201a	Broca's Aphasia	Male
Patient B	Adler/Adler16a		
Patient C	Fridriksson/Fridriksson03a		Female
Patient D	Fridriksson/Fridriksson12a		
Patient E	Adler/Adler20a	Anomic Aphasia	Male
Patient F	Fridriksson/Fridriksson04a		
Patient G	BU/BU12		Female
Patient H	Wright/Wright202a		
Patient I	Adler/Adler23a	Wernicke's Aphasia	Male

Patient J	Adler/Adler06a		
Patient K	Kansas/Kansas23a		Female
Patient L	Tucson/Tucson03a		

Table 1: Table presenting locations of Patient's sessions in AphasiaBank

4.3. Procedure of Sessions

Each of the twelve sessions cover multiple activities designed to test the linguistics abilities of the subjects. All sessions, with the exception of Tucson03a, make use of the same activities. Although, the order in which they appear can be varied. The sessions used in the present study vary in length from 14 minutes 21 seconds to 51 minutes 56 seconds.

All sessions used in this study are conducted in private rooms. They feature the aphasia patient and a Speech and Language Pathologist (SLP) who engages with the subject and assesses their linguistic ability.

All of the sessions begin with the activity described, by the database, as free speech samples (MacWhinney et al, 2011). During this, the subjects are asked whether they can remember their stroke, how their recovery is going and to describe an important event in their life. This allows the SLP to assess the subject's skills in free speech (MacWhinney et al, 2011). These activities are labelled as 'Questions' in the analysis section of this study.

This is followed by a picture describing task in which the SLP will ask the subject 'what is happening in this picture?' (MacWhinney et al, 2011). The pictures are in frames, similar to a comic book, and the task of the subject is to explain the story. Similarly, the next activity requires the subject to recite the story of Cinderella. Picture materials are also available for

this activity to help the patient remember the story. These tasks are labelled 'Picture Story' in the analysis section.

The participants then engage in the 'Procedural Discourse' activity (MacWhinney et al, 2011). This is where subjects are asked how to make a peanut butter sandwich in order to assess how well they can string together contingent events (Longacre, 1990:2). This shall be labelled as 'Instructions' in the analysis.

The next few tasks appear in a different orders depending on the collection site and are completely omitted from Tucson03a. Two of these tasks require the subject to name pictures that appear on given materials. The difference between the tasks is that one uses exclusively nouns and the other verbs (Kaplan, Goodglass, & Weintraub, 2001; Thompson, in preparation for publication). These are labelled 'Picture naming (nouns)' and 'Picture naming (verbs)'.

Finally, there is the 'AphasiaBank repetitions test' (MacWhinney et al, 2011). This tests the patient's ability to string together lists of words, repeat normal sentences and repeat semantically incorrect sentences (e.g. 'Bad weather was caused by long aeroplane delays'). These tasks will be labelled 'Repetitions' in this study.

4.4. Materials used

The materials used in the sessions provide a guideline for the SLP to follow including the instructions that should be given to each participant and any images shown to the subject. Access to these materials is available on the protocol section of AphasiaBank.[3]

The majority of protocols are devised by AphasiaBank, however the session also make use of materials such as the Northwestern Verb Naming test, the Western Aphasia Battery-Revised and the Boston Naming Test, Second Edition, Short Form (Chlo-Reyes & Thompson, 2012; Linguisystems, 2008; Kertezs, 1984; Kertezs, 1982). All of these are used to aid the SLP in assessing the language of the subject.

[3] Materials could not be presented in this study due to them being password protected on the database

5. Methodology

The method is divided into four parts representative of the systematic order in which the data was analysed in this research. The method will present how recorded sessions in AphasiaBank were used to answer the research question.

5.1. Transcribing and Target Words

The first part of the method was to go through the sessions of all participants mentioned in Chapter 5 and record any phonologically misproduced words (tokens) in IPA transcription. These tokens were accompanied by the proposed target word which was either provided by the transcription on AphasiaBank or found in the materials used in the session. Each video was examined twice in attempt to account for any possible human errors that could have taken place during the first viewing.

As well as taking note of the misproduction and target word, each token was given a reference code so that it may be discussed in more detail in later sections. These reference codes correspond with the letter assigned to each patient and the order in which the token appears in the session. For example, the third misproduction of Patient C would be labelled 'C3'.

The first problem encountered was that AphasiaBank provided the target word in a Standard American English orthographical format e.g. 'Stethoscope' would be labelled as such. As this study aims to discuss issues of phonology, stating target words in orthographic format is not enough. This is especially the case in English where the phoneme-orthography relationship is by no means transparent (Spencer, 2000:1). A clear example of the

complexities of the phoneme-orthography relationship in English are silent letters. Therefore it was clear that IPA transcriptions were required.

The IPA transcriptions of the target words were acquired from the Oxford English Dictionary Online (OED). The other option available was to transcribe the target words myself however the advantages of using the OED outweighed this option. Firstly, despite taking multiple modules that revise IPA transcriptions I am an undergraduate student. The OED online states:

> *'A staff of 120 scholars, research assistants, systems engineers, and project managers, plus approximately 200 specialist consultants and readers, have been working on this project since 1993'*
>
> *(OED Online)*

Therefore, in terms of accuracy, the OED is the best option. Secondly, I am not an American English speaker. As mentioned, the data used in this study consists of twelve American English speakers. For this study to be accurate it will need to use the most representative pronunciations of target words i.e. American English target pronunciations. The OED provides IPA transcriptions of words in both English and American English. It is understood that there is more than one American accent however the OED provides a good foundation for what the subject will be likely to be aiming for.

The final aspect that will be taken note of is the activity that the subject is engaging in. Though this has low prominence in this study it may be helpful to include to show patterns in misproductions, in respective to activities, and will also give an idea of where in the data the token was taken from.

5.2. Refining the data

After collecting the data, two inclusion criterion were developed for the tokens in order to make the analysis of phonological misproductions applicable. The criterion are as follows:

1. The token must have a target word/pronunciation
2. The token must be within scope of the target word so much so that a process of phonological misproduction, used in the present study, may be applied

The reason for the first of these criteria is that the misproduction must have something that it is able to be compared to. Without a target pronunciation it will be impossible to see how the subject has misproduced what is being said.

Though it may sound contradictory to the aims of the study (to describe how the patient has misproduced the target) the second criterion is necessary in circumstances where the subject has produced something that is completely unrecognisable to the target word. An example of this is the addition of another syllable in which no sounds from the original syllable have been replicated.

To give this study credibility certain phonological aspects had to be addressed. Though multiple aspects had to be considered they all stem from the issue of 'acceptable forms'. Jeffries (2006) discusses phonological alterations that occur in connected speech. One of the examples that is given is the pronunciation of 'Bad man' (/bædmæn/) being produced as /bæbmæn/ (Jeffries, 2006:54). From a prescriptive perspective this could be considered a 'misproduction' however the vast majority of speech produced in the real world doesn't conform to the dictionary prescribed pronunciations of words (Williford, 1988:1-3).

This is also the case for words produced in isolation. Despite the target words being the ideal form, as well as the form that the misproduced word will be compared to in the present study, there are other ways of producing lexemes that are considered acceptable. German et al (2013) mention the plasticity in the phonological systems of English which can be caused by accents (German et al, 2013). The individual phonemes which may undergo change without having any effect on the meaning of the word are allophones. The allophones which shall be dealt with in this study are often context dependent. For example, little may be pronounced /lɪɪtəl/ or /lɪɾəl/ and still retain the same semantic content. In this case /t/ and /d/ could be perceived as allophones. Yet, if /d/ is in the word initial position, as in dog (/dɒg/), and is changed to /t/, creating /tog/, then the sounds are no longer allophones as the words does not retain the same semantic meaning.

The application of acceptable forms poses a problem in the present study. Although the discipline of accentology has vast amounts of publications, there are no exact guidelines for what is considered as an acceptable form in terms of phonology. The more heavily studied features of allophones in accents consist of glottal stopping and /h/ dropping (McMahon, 2002:94-106). However, to compile a complete list of when sounds are considered acceptable would be incredibly difficult and time consuming. Therefore the best solution would be to judge what an acceptable form is myself. Although I am not an American English speaker, I still have the ability to comprehend American English. Due to media devices such as television, I have long been comprehending American English. Due to this acceptable forms in this study will be based on whether I would consider the word acceptable. However, where possible literature will be provided.

5.3. Identification of Misproductions

The present study makes use of four misproduction types. These are changes in vowels, substitution, assimilation and altercations in word and syllable structure (though labelled syllable structure, the last group will deal with phonotactics). These groups consist of individual types of misproductions. These will be used to analyse the data and then collated into the larger groups in which they appear for the overall result.

The majority of definitions for substitutions, assimilations and syllable structure were sourced from littlebeespeech.com. The website compiles the definitions of phonological processes from existing literature and is used by professional Speech and Language Pathologists (Bleile, 1995; Bowen, 2001; Hedge, 2001; Pena-Brooks, Adriana & Hedge, 2007). All definitions that were not sourced from this website will be cited differently. Any non-cited processes that do not appear in this source will be due to the process not being named in previous literature.

A final note about misproductions is that there may be cases where one misproduction could have two possible explanations e.g. 'Spit' becoming 'pit' could be a consonant cluster or an initial consonant deletion (both types defined later in this section). In the case of this study, this problem does not matter. This is because the individual misproduction types will be regrouped into the four main categories of misproduction for comparison with other aphasia types.

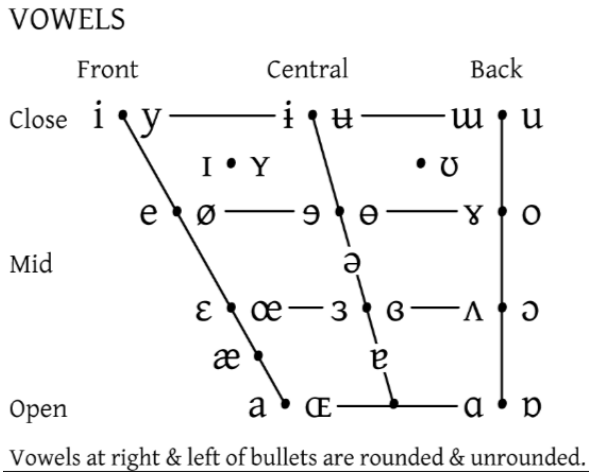
5.3.1. Phonological misproductions of vowels

One of the groups of phonological misproductions that will be dealt with in this dissertation is the misproductions of vowels. The reason for grouping vowels in this way is that vowels

are phonetically described in a different way to consonants. For example, all vowels are all voiced and formed by the tongue and palate which is dissimilar to consonants which are not necessarily voiced and rely upon a range of articulators (Jeffries, 2006:29).

The way of describing vowels is based upon mapping where in the mouth the tongue is positioned in relation to cardinal points presented by Jones' vowel chart (figure 1) (Jones, 1956). It is important to understand that the axis of the chart is not meant to reflect the mouth but rather the shape of the resonating cavity that produces the different vowel sounds (Jeffries, 2006:30).

Figure 1: Jones' Vowel Chart (Jones, 1956)



Therefore the terms used to describe vowels in this study will reflect the changes made to the resonating cavity in the misproductions of the sound. The exact terms and examples of each are as follows.

5.3.1.1. Vowel fronting and backing

If the tongue has been pushed forwards, making the resonating cavity smaller, for a sound that was meant to be produced as a back vowel the misproduction will be labelled as fronting. An example of fronting in a word is if a patient uses the word ‘soon’ or /su:n/ that is produced ‘seen’ or /si:n/.

The exact opposite of this misproduction, if the resonating cavity has been pulled backwards for a sound that was meant to be produced at the front, would describe backing. An example of backing could be if ‘seen’ or /si:n/ was pronounced as ‘soon’ or /su:n/.

5.3.1.2. Vowel Heightening and lowering

The process of vowel heightening occurs when the tongue body is positioned further towards the palate. Although the axis of the vowel chart varies from ‘open’ to ‘close’, the terms ‘heightening’ and ‘closing’ are just as commonly used. This means that vowel opening and vowel lowering are synonyms and the same applies for vowel closing and heightening. An example of vowel heightening would be if the word ‘mat’ or /mæt/ was produced as ‘meet’ or /mi:t/.

Vowel lowering is the opposite, where the resonating cavity is made larger. An example of this is if the word ‘meet’ or /mi:t/ was produced as the word ‘mat’ or /mæt/.

5.3.1.3. Vowel centralising

Also known as centripetal vowel reduction, vowel centralising is the process of producing any vowel sound as a vowel closer to the central /ə/ or schwa sound. This is a common

process in natural phonology as the schwa sound is the least physiologically difficult vowel for a human to produce (Crosswhite, 2004). An example of a vowel centralising could be replacing the word ‘hair’ or /hɛːɹ/ with ‘her’ or /həɹ/.

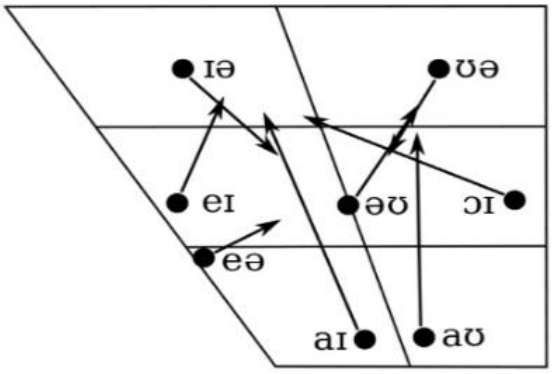
5.3.1.4. Diphthongization and monopthongization

The process of diphthongization is turning a monophthong (singular vowel), such as the ones featured on Jones’ chart, into a diphthong. A diphthong is formed by a combination of two different positions of the tongue with an audible glide from one to the other (Jeffries, 2006:25). An example of diphthongization would be if the word ‘tor’ or /tʊɹ/ was pronounced as ‘tour’ or /tʊəɹ/.

Again, monopthongization is the opposite. This would be producing a diphthong as a monophthong such as ‘tour’ or /tʊəɹ/ as ‘tor’ or /tʊɹ/.

Diphthongs may also, within themselves, undergo the vowel misproductions that have previously been mentioned such as fronting. Figure 2 presents Jones’ chart with reference to diphthongs rather than monophthongs as a guideline for diphthong internal processes that shall be used in this study.

Figure 2: Diphthong Chart ('www.Phon.ucl.ac.uk', 2017)

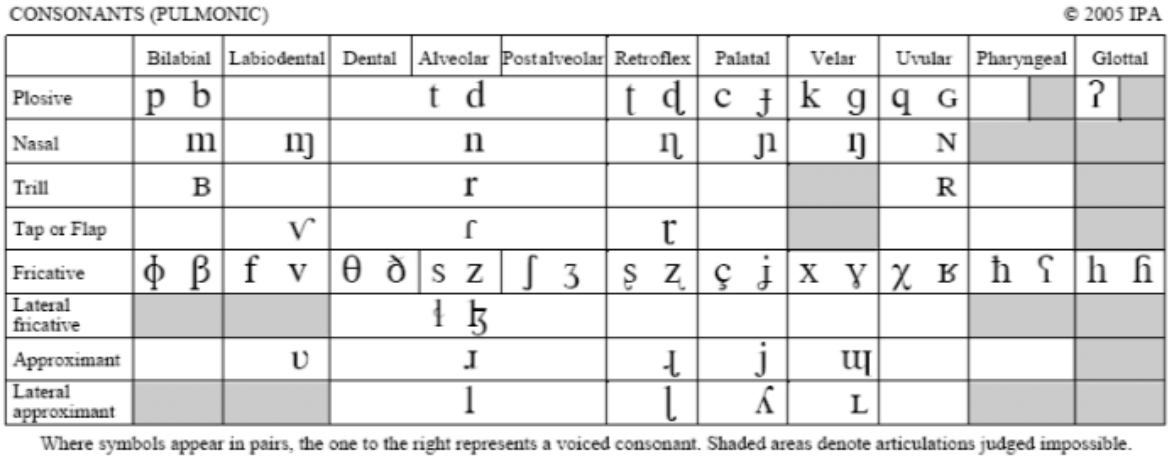


5.3.2. Phonological Substitution

Phonological substitution is a phonological process whereby a language user will replace a sound with another often motivated by vocal or perceptual restraints (Jones, 1993: 102). As already mentioned this study will not necessarily only look at the misproductions caused by vocal constraints. This is due to the attempt to be more descriptive of what is actually phonologically occurring. Because of this some of the types of substitution that will be mentioned here do not conform to what has been previously written about. Rather, it will describe what sound has been substituted for the intended sound.

A reference point for the movement of consonants is the 2005 revised pulmonic consonant IPA chart (figure 3). This will help to show how the consonant has been swapped by the speaker.

Figure 3: Consonant IPA Chart (2005 revised) (Trawick-Smith, 2011)



CONSONANTS (PULMONIC) © 2005 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

5.3.2.1. Substitution of place

The place of articulation describes what articulators are involved in the production of the sound made by the speaker. These account for the columns in figure 3.

This study also includes the fronting and backing of fricatives. Although fronting and backing is normally used exclusively for the description of the places mentioned previously, this study will discuss the movement of fricatives by labelling them ‘fronting of fricative’ or ‘backing of fricative’.

Labialization, in the case of this study, means the replacing of a consonant for a labialized consonant. Other studies discuss the labialization of consonants by using diacritics (Bender, 1963:335). For example, a velar consonant may be labialized to form a labiovelar consonant. However, in this study the use of the term labialization will describe a consonant being substituted for a bilabial consonant.

Misproduction Label	*Definition*	*Example*
Fronting	The process of substituting a velar or palatal sound with an alveolar sound (Smit, 2004:12).	Pronouncing the word 'cat' (/kæt/) as 'tat' (/tæt/)
Backing	The process whereby an alveolar is substituted with a velar sound.	The word 'tat' (/tæt/) being pronounced as 'cat' (/kæt/)
Labialization	The replacing of any consonant for a labialized consonant	The word dog or /dɒg/ became bog (/bɒg/)
Labiodentalization	The changing of any consonant for a labiodental consonant	The word 'should' (/ʃʌd/) becomes fud (/fʌd/)
Alveolarization	The changing of a non-alveolar consonant to an alveolar consonant.	The word threw (/θɹu:/) being substituted for true (/tɹu:/)
Fronting of fricative	The replacing of any fricative for another produced further forward in the mouth	The word 'thrill' or /θɹɪl/ being substituted for 'frill' or /fɹɪl/.
Backing of fricative	The replacing of any fricative for another produced further backwards in the mouth	The word 'frill' (/fɹɪl/) becomes 'thrill' (/θɹɪl/)

Table 2: Table showing specific substitutions of place used in this study

5.3.2.2. Substitution of manner

Manner is the way in which we describe the type of sound made by the speaker. These account for the rows on the left of figure 3.

Some of the substitutions of manner used in this study are not necessarily 'named' as the rest of the more established processes are. Therefore the types of the substitution will describe themselves in their titles.

Misproduction Label	*Definition*	*Example*
Stopping	When a fricative or affricate is changed into a plosive sound (The terms stop and plosive are synonyms)	'Fill' (/fɪl/) is substituted for 'till' or (/tɪl/)
Fricative replaces stop	The opposite of stopping. When fricative replaces a stop	'Shot' (/ʃɒt/) is substituted for 'tot' (/tɒt/)
Fricative replaces approximant	When fricative sound replaces an approximant	'Shot' (/ʃɒt/) is substituted for 'rot' (/ɹɒt/)
Fricative replaces lateral approximant	When fricative sound replaces a lateral approximant	'Shot' (/ʃɒt/) is substituted for 'lot' (/lɒt/)
Nasal replaces stop	When a nasal sound replaces a stop	'Not' (/nɒt/) is substituted for 'pot' (/pɒt/)

Nasal replaces fricative	When a nasal sound replaces a fricative sound	'Not' (/nɒt/) is substituted for 'shot' (/ʃɒt/)
Approximant replaces stop	When an approximant sound replaces a stop	'Rot' (/ɹɒt/) is substituted for 'pot' (/pɒt/)
Lateral approximant replaces stop	When a lateral approximant replaces a stop	'Lot' (/lɒt/) is substituted for 'pot' (/pɒt/)
Lateral approximant replaces fricative	When a lateral approximant replaces a fricative	'Lot' (/lɒt/) is substituted for 'shot' (/ʃɒt/)
Lateral approximant replaces approximant	A lateral approximant replaces an approximant	'Lot' (/lɒt/) is substituted for 'rot' (/ɹɒt/)

Table 3: Table showing the specific substitutions of manner used in this study

5.3.2.3 Gliding, affrication and deaffrication

The following three types of substitution do not fit the previous patterns of changing in manner or place. This is because these forms of substitution change both manner and place.

Misproduction Label	*Definition*	*Example*
Gliding	One of the more specific types of substitution. This is when the	'Rabbit' (/ɹæbɪt/) becomes 'wabbit' (/wæbɪt/)

	phoneme /ɹ/ is changed to a /w/ sound. It also describes when a /l/ phoneme has become a /w/ or /j/ sound	
Affrication	is the process of substituting a non-affricate sound into an affricate (a sound that combines a stop and fricative)	'Fair' (/feə/) becomes 'chair' (/tʃeə/)
Deaffrication	The opposite of affrication. Where an affricate sound is changed into a non-affricate	'Chair' (/tʃeə/) becomes 'fair' (/feə/)

Table 4: Table showing specific types of substitution for both manner and place

5.3.3. Phonological assimilation

Lee et al (2006) describe assimilation as the process of change in one sound that conforms more closely to an immediately or nearly adjacent sound (Lee et al, 2006:515). This dissertation uses assimilation to account only for sounds that have assimilated to the exact same sound. This is because explaining phonological features of sounds would take up too many words of which are limited.

It was mentioned that vowels should be treated differently to consonants in this study. However, in the case of assimilation vowels will be labelled as such. The reason this is done is because this dissertation focuses on assimilation being the changing of sounds to the exact sound that also appears in the word. Therefore, the chances that the speaker has

changed the vowel on this basis of the vowel change misproduction type rather than assimilating are reduced.

As well as the individual description for assimilation the more general label ‘assimilation’ also covers five other processes:

Misproduction Label	*Definition*	*Example*
Assimilation	The changing of a sound to another immediate of nearly adjacent sound	‘Dam’ (/dæm/) assimilates to ‘dad’ (/dæd/)
Denasalization	When a nasal sound becomes a non-nasal sound	‘Man’ (/mæn/) assimilates to ‘fan’ (/fæn/)
Coalescence	When two phonemes assimilate to one that has similar features	‘Spoon’ (/spu:n/) assimilates to ‘foon’ (/fu:n/).
Voicing	When an unvoiced consonant becomes its voiced counterpart	The word too (/tu:/) becomes ‘do’ (/du:/)
Devoicing	The opposite of voicing. When a voiced consonant becomes it’s devoiced counterpart	‘Do’ (/du:/) assimilates to ‘to’ (/tu:/)

Reduplication	When a complete or incomplete syllable is repeated. This could be in place of another syllable or not	'Dummy' (/dʌmi:/) assimilates to 'dumdum' (/dʌmdʌm/).

Table 5: Table showing specific types of assimilation used in this study

Reduplication differs slightly from the previous examples as it refers to a full syllable rather than an individual phoneme. Structural errors such as this are explored more in the next subsection. However, reduplication comes under assimilation due to it being the repeating of an occurrence co-existing in the word.

5.3.4. Misproductions in syllable structure

The final group of misproductions that are used in this study are misproductions in syllable structure. Syllable structure does not only look at whole syllables but covers the part of phonology that looks at how phonemes combine in a word. This is also known as the study of phonotactics. Therefore, this misproduction type will cover both misproductions in word and syllable structure yet will be labelled as misproductions in syllable structure.

Misproduction Label	*Definition*	*Example*

Cluster reduction	The process of omitting a consonant when two consonants appear consecutively	'Skate' (/skeɪt/) becomes 'sate' (/seɪt/) or 'Kate' (/keɪt/)
Added consonant cluster	The process inserting a consonant adjacent to another consonant	'Too' (/tu:/) becomes 'true' (/tɹu:/)
Initial consonant deletion	The process of omitting a consonant from a word when it is in the word initial position	'My' (/mɑɪ/) becomes 'I' (/ɑɪ/)
Added initial consonant	The process of adding a consonant to the beginning of a word	'I' (/ɑɪ/) becomes 'My' (/mɑɪ/)
Final consonant deletion	The process of omitting a consonant from a word when it is in the word final position	'Think' (/θɪnk/) becomes 'thin' (/θɪn/)
Added final consonant	The process of adding a consonant to a word when it is in the word final position	'thin' (/θɪn/) becomes 'Think' (/θɪnk/)
Weak syllable deletion	The deletion of an unstressed syllable in a word	'Banana' (/bənɑ:nə/) becomes 'nana' (/nɑ:nə/)
Epenthesis	When a vowel sound, usually /ə/, is inserted between two consonants.	'Drink' (/dɹɪnk/) becomes 'derink' (/dəɹɪnk/)

Metathesis	The re-arranging of sounds or syllables in a word (Hume et al, 2001)	'Banana' (/bənɑ:nə/) becomes 'nabana' (/nəbɑ:nə/)

Table 6: Table showing types of misproductions in syllable structure used in this study

6.4. Counting of Misproductions

The final task consisted of tallying the types of misproductions of each token produced by the patients. Each misproduction type was accounted for thus meaning that multiple misproduction types could occur in one token. For example, if the word 'dog' (/dɒg/) was pronounced /tɒk/ the study would count two tokens of devoicing. This is because the aim is to see how often a type of misproduction occurs in a patient's language.

After each individual misproduction type was counted they were regrouped into the four major misproduction types (Misproduction of vowels, Substitutions etc.). All individual misproduction types within these groups were added together so that there would be a total number for each major misproduction group per patient. For example, fronting, backing and all other processes of substitution would be totalled per patient. The major groups would then be made into a percentage out of all of the misproductions made by each patient e.g. out of all the misproductions made by Patient A 25% were substitutions.

7. Results

The results that are presented in this chapter will be split into two groups. Section 7.1 will address the refining of the results. It will address both the tokens that were discounted for being too far from the target pronunciation and issues of acceptable forms which were discussed in Chapter 6. These appear in twelve tables each signifying an individual patient. These will appear in order of both the Aphasia type and the alphabetic coding system mentioned in the data section. The full accounts of misproductions taken from the sessions are available in the appendix. All target productions are taken from the OED online (OED, 1888-2017).

7.1. Misproductions and Misproduction types

The following tables consist of all discounted misproductions from patients with Broca's aphasia.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
A9	Sitting	/sɪtɪŋ/	/sɪdɪ/	Final consonant deletion	Picture naming (nouns)
A12	Biting	/baɪtɪŋ/	/baɪdɪŋ/	N/A	Picture naming (Verbs)
A16	Brutal	/bruːtəl/	/bərdəl/	Metathesis, vowel centralizing	Repetitions

Table 7: Patient A - data omitted from the study

Patient A misproduced 16 words in total of which 18 different misproduction types occurred. Token A12 was not counted as a misproduction due to the voicing of an alveolar plosive being a common assimilation in everyday speech particularly in the phonological environment between two voiced sounds (McMahon, 2002). This is also applicable to misproduction types that may appear to occur in A9 and A16. However, in these instances, other misproduction types occurred simultaneously. Therefore, the misproduction types that cannot be deemed an acceptable form within these tokens have been considered in the results.

Code.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
B5	Company	/kʌmpəni:/	/kʌntəni:/	Alveolarization	Questions
B14	Firemen	/ˈfaɪəɹmən/	/ʌmbəmən/	N/A	Picture story
B18	Slipper	/ˈslɪpəɹ/	/sepəɹ/	Cluster reduction	
B19	Prince	/pɹɪns/	/pɹen/	Final consonant deletion	
B24	Touch	/tʌtʃ/	/tə:p/	Deaffrication	Picture naming (verbs)
B25	Cutting	/kədɪŋ/	/kʌdɪŋ/	N/A	

Table 8: Patient B - Data omitted from the study

Patient B misproduced 30 words in total of which 42 misproduction types occurred. Token B14 was withheld from the study. Despite the Patient's ability to correctly produce the second syllable, no misproduction type used in this study showed to be applicable due to lack of recognition in the first syllable. B25 was also not considered in the results due to the

common acceptability of vowel centralising (Crosswhite, 2004). The same can be said for the vowel misproduction in B24. Similarly, the vowels in B18 and B19 did not match the target pronunciation. However, due to the closeness of these (refer to figure 1) they were treated as allophones.

The misproduction of the nasal in in B5 was also not taken note of. As mentioned, the granting of acceptability is through what I would consider acceptable. Should the other Misproduction type have not occurred in the token, then the alveolarization of the nasal would be recognisable.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
C5	Soccer	/ˈsɑkəɹ/	/ˈsɑktə/	Added cluster	Picture story
C7	Umbrella	/əmˈbɹɛlə/	/ɒpɹənə/	N/A	
C9	Umbrella	/əmˈbɹɛlə/	/bəbɹæn/	N/A	
C10	Umbrella	/əmˈbɹɛlə/	/muːˈpɹʌmblɪ/	N/A	
C14	Cinderella	/sɪndəɹelə/	/sɛndɹɪn/	N/A	
C21	Beaver	/ˈbivəɹ/	/ˈbiːðiː/	Backing of fricative, assimilation	Picture naming (nouns)
C22	Beaver	/ˈbivəɹ/	/ˈbiːbɹə/	Assimilation, metathesis	
C26	Barking	/ˈbɑːkɪŋ/	/ˈbɒkɪŋ/	N/A	Picture naming (verbs)
C28	Bird	/bəɹd/	/bʌd/	Cluster reduction	Repetitions

Table 9: Patient C - Data omitted from the study

Patient C misproduced 35 words in total of which 38 misproduction types occurred. Tokens C7, C9, C10 and C14 were all discounted due to no misproduction types being applicable. C26 was also discounted due to the variability in vowel lengths in different accents (Aaronson, 2013:153). The vowels in C21, C22 and C28 were also not taken into consideration due to the issue being only with the length of the vowel productions. C5 was, again, not considered because it is understood that some accents are American English speakers are not rhotic (Labov, 1966).

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
D1	Little	/ˈlɪdəl/	/ˈlɪl/	N/A	Questions

Table 10: Patient D - Data omitted from the study

Patient D misproduced 11 words of which 14 misproduction types occurred. Token D1 was excluded from the research as it was deemed an acceptable form. This is due to the use of 'lil' (/ˈlɪl/) being a common colloquial form of the word 'little'.

The following tables consist of misproductions from Patients with Anomic aphasia.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
E2	Lung	/ləŋ/	/lʌŋ/	N/A	Questions
E10	January	/ˈdʒænjəˌwɛɹi/	/ˈdʒænjuwɛɹɪɛɹɪ/	Reduplication	

Table 11: Patient E - Data omitted from the study

Patient E misproduced 42 words of which 53 misproduction types occurred. Token E2 was withheld from the study due to the production /lʌŋ/ being correct in the English pronunciation (OED, 2007). The changing of the schwa vowel for an /u/ vowel in E10 was also withheld due to the allophonic nature of the two vowels in this instance.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
F2	Before	/bəˈfɔəɹ/	/fɔə/	Weak syllable deletion	Questions
F11	Mother	/ˈməðəɹ /	/ˈməwə/	Lateral approximant replaces fricative	
F13	Daughter	/ˈdɔdəɹ/	/ˈdɔɹəɹ/	Assimilation	
F14	Grandmother	/ˈgɹændˌməðəɹ/	/ˈzænˌməðə/	Cluster reduction, fricative replaces stop	
F36	Weather	/ˈwɛðəɹ/	/ˈwɛləɹ/	Alveolarization	Repetitions

Table 12: Patient F: Data omitted from the study

Patient F misproduced 36 words of which 44 misproduction types occurred. The consonant /ɹ/ in the word final position in tokens F2, F11 and F14 were not accounted for as final consonant deletion. Despite tokens F36 and F13 producing /ɹ/ in the word final position, the rhoticity of a speaker's accent is often not binary. The English pronunciations of F2, F11 and F14 also do not produce the word final consonant. Therefore these misproductions were not counted.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
G4	Erase	/ɪˈɻeɪz/	/ɻiːˈeɪs/	Metathesis	Picture story

Table 13: Patient G - Data omitted from the study

Patient G misproduced 15 words of which 19 misproduction types occurred. The misproduced vowel that occurs at the beginning of G4 was excluded from the research due to /iːɻeɪz/ being considered as an acceptable form of American pronunciation. This is also the case with the devoicing of the word final consonant in the same token however evidence for this is backed by OED (OED).

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
H4	Rehabilitation	/ˌɻihəˌbɪliˈteɪʃən/	/ˌɻihəˌbəleɪs/	N/A	Questions
H5	Crap	/kɻæp/	/kɻæpələ/	N/A	
H7	Math	/mæθ/	/mæθɪŋə/	N/A	

Table 14: Patient H - Data omitted from the study

Patient H misproduced 21 words of which 28 misproduction types occurred. Tokens H5 and H7 were omitted from the study due to no misproduction type providing a reasonable explanation for what occurred. The patient does appear to achieve the target pronunciation in the initial syllable. However this is followed up by unaccountable syllables which in no way connect to the initial syllable. A possible explanation for this could be a colloquialization. In this case it may be that I have got the target word wrong. However, as I

was unable to find any definitions of what I thought the patient was attempting to produce

H5 and H7 were marked as not applicable to the study.

H4 also appears to achieve the target in the initial syllable. However this is followed by, not only syllable deletion, but the production of sounds that again could not be related to the sounds in the other syllables (one in which it occurs, prior or latter). Therefore H4 was not counted in the results.

The following tables consist of misproductions from Patients with Wernicke's Aphasia.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
I8	Food	/fud/	/flu:d/	Added cluster	Repetitions

Table 15: Patient I - Data omitted from the study

Patient I misproduced 13 words of which 17 misproduction types occurred. The lengthening of the vowel in token I8 was not included in the results. This is due to the lengthening of vowels not necessarily creating a semantic difference in some accents (Aaronson, 2013:153). Therefore making /fu:d/ an acceptable pronunciation.

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
J1	Better	/ˈbɛdəɹ/	/ˈbɛgə/	Backing	Questions

Table 16: Patient J - Data omitted from the study

Patient J misproduced 7 words of which 11 misproduction types occurred. The consonant in the word final position of J1 was not counted due to already discussed issues with rhoticity (Labov, 1966).

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
K3	Umbrella	/əmˈbɹɛlə/	/plʌðə/	N/A	Questions
K5	liked	/laɪkt/	/haɪkəd/	Fricative replaces lateral approximant	Repetitions

Table 17: Patient K - Data omitted from the study

Patient K misproduced 18 words of which 20 misproduction types occurred. Token K3 was not considered in the results due none of the misproduction categories being able offer a solution for what had occurred in the word.

The insertion of the schwa vowel and voicing of the alveolar plosive in token K5 was also not counted as a misproduction. As previously mentioned the voicing of alveolar plosives is a normal occurrence in everyday speech (McMahon, 2002). Arguably, metathesis could have been said to have occurred however the addition of a schwa in this instance is acceptable thus changing the phonological environment of the alveolar plosive (appears after a voiced sound rather than an unvoiced) making the voicing of the alveolar plosive also acceptable (MacMahon, 2002).

Code	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Misproduction Type(s)*	*Activity*
L1	Situation	/sɪtjuːˈeɪʃən/	/sɪtʃjuːˈɪʃən/	Monopthongization	Questions
L12	Meet	/mit/	/ni:t/	Alveolarization	Picture story
L13	Leave	/liv/	/li:z/	Alveolarization	

Table 18: Patient L - Data omitted from the study

Patient L misproduced 16 words of which 19 misproduction types occurred. The affrication that appears in L1 was discounted from the research as this is considered an acceptable form.

The lengthening of vowels that appear in L12 and L13 were also not accounted for due to the same reasons that were discussed earlier (Aaronson, 2013:153).

7.2. Collated Results

After the misproduction types had been gratified, and any non-applicable misproduction types removed from the study, the results were collated in order to address the research question.

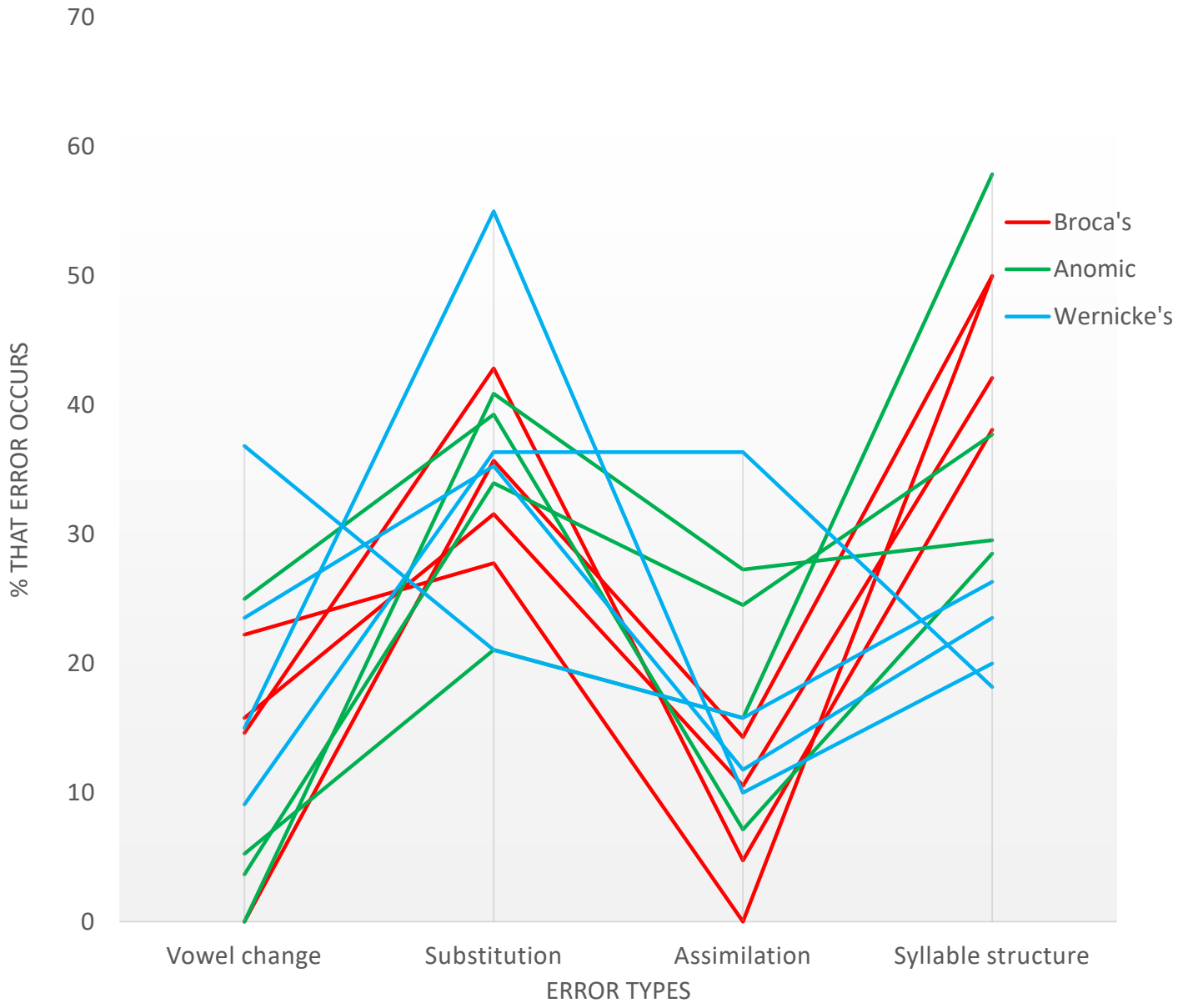
The specified misproduction types were regrouped into their more broad categories as to address the question. The following percentages are accumulated out of the total of the misproduction types made.

Aphasia type	Patient	Phonological misproduction type							
		Vowel change		Substitution		Assimilation		Syllable Structure	
		Total no.	Percentage of error (%)	Total no.	Percentage of error (%)	Total no.	Percentage of error (%)	Total no.	Percentage of error (%)
Broca's	A	4	22.22%	5	27.77%	0	0%	9	50%
	B	6	14.63%	18	42.85%	2	4.76%	16	38.09%
	C	6	15.78%	12	31.57%	4	10.52%	16	42.10%
	D	0	0%	5	35.71%	2	14.28	7	50%
Anomic	E	2	3.77%	18	33.96%	13	24.52%	20	37.73%
	F	0	0%	18	40.90%	12	27.27%	13	29.54%
	G	1	5.26%	4	21.05%	3	15.78%	11	57.89%
	H	7	25%	11	39.28%	2	7.14%	8	28.51%
Wernicke's	I	4	23.52%	6	35.29%	2	11.76%	4	23.52%
	J	1	9.09%	4	36.36%	4	36.36%	2	18.18%
	K	3	15%	11	55%	2	10%	4	20%
	L	7	36.84%	4	21.05%	3	15.78%	5	26.31%

Table 19: Table presenting the percentage of misproduction types made by all patients

Before discussing the results they will be presented in a graph so that the correlations may be shown more clearly. The individual lines, representing each of the subject's misproductions, have been coded dependent on their aphasia type. This is to allow the study to focus on whether the results show if misproduction types are governed by the aphasia type. Any specific information of misproduction types which requires referral to an individual patient can be followed by using Table 19.

Figure 4: Figure illustrating the correlation between Aphasia types and misproduction types



8. Discussion

The aim of this research was to see whether the types of misproductions produced by aphasia patients are governed by the type of aphasia or are completely individual to the patient. What the results appear to show is that the types of misproductions produced by patients are by no means individual. However, it also appears to show that the misproduction types are not only governed by the aphasia type but instead are relative to aphasia as a whole.

Speaking generally, what this research has found is that the most common misproduction types produced by aphasia patients are misproductions in substitution and syllable structure. It also shows, generally, that the misproduction of vowels and use of assimilation are least common amongst aphasia patients.

8.1. Discussion of vowel change

The range of percentage of vowel change out of the total misproduction types stretches from 0% (Patients D and F) to 36.84% (Patient L).

Rank	*Patient*	*Aphasia type*	*% of vowel changes*
1	L	Wernicke's	36.84%
2	H	Anomic	25%
3	I	Wernicke's	23.52%
4	A	Broca's	22.22%
5	C	Broca's	15.78%
6	K	Wernicke's	15%

7	B	Broca's	14.63%
8	J	Wernicke's	9.09%
9	G	Anomic	5.26%
10	E	Anomic	3.77%
11	D & F	Broca's & Anomic	0%

Table 20 Table presenting the ranking order in which Patients misproduced vowels

As table 20 shows the variety of which the aphasia types occur in relevance to rank are in no way ordered. From the data presented by Table 20 it is clear that Wernicke's patients have a tendency to misproduce vowels more commonly. However, the study cannot claim that Wernicke's patients produce more vowel changes as examples of both Anomic and Broca's Patients occur in between the Wernicke's patients.

Besides Patient H, the remaining Anomic aphasia Patients all appear to have the lowest percentages of vowel change. It could be said that Patient H is deviant from the remainder of the results for Anomic aphasia. Thus the study would be able to conclude that Wernicke's patients have a lower tendency to misproduce vowels. However, due to the study using only using four patients for each aphasia type, this would mean that a 25% of the results for Wernicke's aphasia are considered deviant. Therefore this statement can only be suggested.

8.2. Discussion of substitution

The range of percentage of substitutions out of the total misproduction types stretches from 21.05% (Patient G & L) to 55% (Patient K). Evidence from figure 4 supports the statement that the types of misproductions used by patients are governed by aphasia in general. In fact, there is only one deviation from this claim evident in the results. This

deviation is from Patient H (Wernicke's) who misproduced a much higher amount of vowels than the other patients (11.84% more).

Due to the claim that aphasia governs the misproduction types being more general, we can say that the deviation only consists of 8.33% of the study rather than 25%. This is because we have taken data of 12 aphasics when not categorising the patients into their respective groups. This therefore allows the study to be more confident in making this claim.

Rank	*Patient*	*Aphasia type*	*% of Substitutions*
1	K	Wernicke's	55%
2	B	Broca's	42.85%
3	F	Anomic	40.90%
4	H	Anomic	39.28%
5	J	Wernicke's	36.36%
6	D	Broca's	35.71%
7	I	Wernicke's	35.29%
8	E	Anomic	33.96%
9	C	Broca's	31.57%
10	A	Broca's	27.77%
11	G & L	Anomic & Wernicke's	21.05%

Table 21: Table presenting the ranking order in which Patients used substitutions

Once again, the ranks in which the aphasia types occur is in no way ordered. In this instance even more so due to the aphasia types featured in top three also featuring in the bottom three. In general, the research has suggested that aphasia governs the misproduction types

used most often. However, In terms of looking at only substitution, the claim that aphasia types do not govern the misproductions of patients is heavily supported.

8.3. Discussion of assimilation

The range of percentage of assimilations out of the total misproduction types varies from 0% (Patient A) to 36.36% (Patient J). Figure 4 shows that patients of all aphasia types had a tendency to produce less assimilations than substitutions and misproductions in syllable structure. The only deviation from this result is Patient J whose amount of assimilations and misproductions in syllable structures were equal (36.36%). Looking at the study as a whole, this again supports that misproductions are governed by general aphasia.

Rank	*Patient*	*Aphasia type*	*% of Assimilations*
1	J	Wernicke's	36.36%
2	F	Anomic	27.27%
3	E	Anomic	24.52%
4	L & G	Wernicke's & Anomic	15.78%
5	D	Broca's	14.28%
6	I	Wernicke's	11.78%
7	C	Broca's	10.52%
8	K	Wernicke's	10%
9	H	Anomic	7.14%
10	B	Broca's	4.76%
11	A	Broca's	0%

Table 22: Table presenting the ranking order in which Patients used assimilation

Looking specifically at assimilation, the study, once again, cannot support the claim that assimilations are governed by the aphasia type. This is illustrated in the fact that there is a 26.36% difference between Wernicke's Patients, a 14.28% difference between Broca's Patients and a 20.13% difference between Anomic Patients. It is also made clear by the order in which the aphasia types are ranked. Though Broca's patients appear to be towards the bottom of the ranks, Patient D appears within the top 5. Therefore no accurate statement regarding Broca's aphasia can be concluded.

8.4. Discussion of misproductions in syllable structure

The range of percentage of misproductions in syllable structure out of the total misproduction types varies from 18% (Patient J) to 57.89% (Patient J). Not only are misproductions in syllable structure the highest minimum percentage out of all misproduction types but it was also the highest maximum percentage.

All besides one subject (Patient J), produced more misproductions in syllable structure than assimilations. Amongst all aphasia types Misproductions in syllable structure were the highest type of misproduction.

Rank	*Patient*	*Aphasia type*	*% of misproductions in syllable structure*
1	G	Anomic	57.89%
2	A & D	Broca's & Broca's	50%
3	C	Broca's	42.10%

4	B	Broca's	38.09%
5	E	Anomic	37.73%
6	F	Anomic	29.54%
7	H	Anomic	28.51%
8	L	Wernicke's	26.31%
9	I	Wernicke's	23.52%
10	K	Wernicke's	20%
11	J	Wernicke's	18.18%

Table 23: Table presenting the ranking order in which Patients misproduced syllable structures

Perhaps the most interesting, the results presented by Table 23 do suggest that perhaps aphasia types are what governs misproductions in syllable structure. This is shown by the order in which the patients occur in the rankings. The data suggests that Wernicke's aphasia patients definitely produce the least percentile amount of misproductions in syllable structure in comparison to the other aphasia types.

As for the other two aphasia types, the results show that the misproductions in syllable structure that occur in Broca's patients have a tendency to be higher than that of Anomic Patients. However, the deviation of Patient G means that the study cannot be conclusive in this statement.

9. Conclusion

Based on information provided by the National Aphasia Association, I hypothesised that the findings would show that the aphasia types would not govern the types of misproductions made by the subjects (NAA, 2016). In a sense, the findings appear to show this to be true. However, evidence from the hypothesis states that I predicted that the types of misproductions would be in no way homogenous. This statement was heavily disputed by the findings.

Besides a few deviants, the results show that the types of misproductions tend to be similar of all patients of any aphasia type. Although, concluding this may be too generous with the results.

To bring these conclusions to a more appropriate level, this research definitely does suggest that the most common types of misproduction to occur in aphasia patients are substitutions and misproductions in syllable structure. Thus suggesting that assimilations and the misproductions of vowels are not as common in aphasic language. A reason why the results may show that substitution appears to be one of the most common types of misproduction is that there are simply more subcategories than the other misproduction types. However, this is not the case for misproductions of syllable structure. Therefore to claim bias due to this is not very credible.

Addressing the research question, the only relevant result that appears to be present is that misproductions in syllable structure look likely to have a correlation with the type of aphasia. The results suggest that Wernicke's aphasics do produce less misproductions in syllable structure. However, due to a 25% deviation, we cannot state that the Anomic aphasics produce the second most and Broca's aphasics the most.

Besides this, the results are somewhat inconclusive as to whether aphasia types govern the type of misproduction. Misproductions in syllable structure do suggest that there is some correlation with the aphasia types and it could be argued that Anomic Aphasics produce the least amount of misproductions in vowel change. However, both claims are constrained by the 25% deviants that occur in the research.

9.1. Limitations and Future Research

The most prominent limitation in this study is the relatively small amount of data. Though it did initially seem enough to take four patients from each aphasia type (in terms of accounting for variation). The fact that one deviant means that 25% of the results for each aphasia type are flawed creates a lack of credibility.

Another issue of this research is the use of percentages. Due to this study using relatively small amounts of data, the use of percentages seems relevant. However, percentages can often lead to inaccurate results (Yates & Carlson, 1986). This could be explained by the variant amounts of misproductions from each participant. Though some subjects may have produced a higher percentage of substitutions it is possible that they may have produced less actual substitutions than other subjects. But, whilst they produced more misproductions overall the subject's percentage is lowered. Therefore statistical evidence would support the study even further.

Also, though the point was argued for, perhaps using myself as the judge of what would be considered an acceptable form was not the best option. The ideal scenario for this study would have been access to multiple American English speakers. A pilot study could be

conducted in which recordings of the misproductions are compiled. From there, the American English speakers would have to point out what could not be understood.

In terms of future research, there are a whole number of factors of this dissertation that could be looked at more closely. As this study found that some correlation appeared between the aphasia types and misproductions in syllable structure, I suggest a closer examination into this with more data. Besides that, any one of the groups of misproductions could be looked into in more detail. As I was unable to conclude any answers, I can only hope that enough patterns have emerged to encourage future research.

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11. Appendix

11.1. Tables of all misproductions by Patients A-L

The following tables consist of all misproductions from patients with Broca's aphasia.

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
A1	House	/haʊs/	/hʊəs/	Vowel heightening	Questions
A2	Kid	/kɪd/	/tɪd/	Fronting	Picture story
A3	Soon	/suːn/	/stuːn/	Added cluster	
A4	Climb	/klaɪm/	/traɪm/	Fronting	
A5	Arrive	/əɹaɪv/	/ɹaɪv/	Weak syllable deletion	
A6	Rough	/ɹʌf/	/ɹʌp/	Stopping	
A7	Toothbrush	/tuːθbɹʌʃ/	/tuːbɹʌʃ/	Cluster reduction	Picture naming (nouns)
A8	Toothbrush	/tuːθbɹʌʃ/	/tuːbuːs/	Cluster reduction, fronting	
A9	Sitting	/sɪtɪŋ/	/sɪdɪ/	Final consonant deletion	
A10	Sphinx	/sfɪŋks/	/spɪŋks/	Stopping	
A11	Cutting	/kʌtɪŋ/	/kætɪŋ/	Vowel fronting	Picture naming (Verbs)
A12	Biting	/bɑɪtɪŋ/	/bɑɪdɪŋ/	N/A	
A13	Sock	/sɒk/	/sɒks/	Added cluster	Repetitions
A14	Arrived	/əɹaɪvd/	/ɹaɪvd/	Weak syllable deletion	
A15	Important	/ɪmpɔːtənt/	/æpɔːtənt/	Vowel Lowering, cluster reduction	
A16	Brutal	/bruːtəl/	/bərdəl/	Metathesis, vowel centralizing	

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
B1	Thing	/θɪŋ/	/θɪnk/	Fronting	Questions
B2	Go	/gəʊ/	/guː/	Monopthongization	
B3	Go	/gəʊ/	/guː/	Monopthongization	
B4	Work	/wəːk/	/wɪk/	Vowel fronting	
B5	Company	/kʌmpəniː/	/kʌntəniː/	Alveolarization	
B6	For	/fɔːɹ/	/pɔːɹ/	Stopping	
B7	Window	/wɪndoʊ/	/mɪŋoʊ/	Assimilation, backing	
B8	House	/haʊs/	/xaʊs/	Fronting	
B9	Window	/wɪndoʊ/	/vɪngoʊ/	Fricative replaces approximant, backing	

B10	Window	/wɪndoʊ/	/ɪngoʊ/	Initial consonant deletion, backing	
B11	Umbrella	/əmˈbɹɛlə/	/bɛlə/	Weak syllable deletion, cluster reduction	
B12	Umbrella	/əmˈbɹɛlə/	/ɪlɹə/	Weak syllable deletion, initial consonant deletion, metathesis, vowel heightening	
B13	Girl	/gəɹl/	/biːɹl/	Fronting, vowel fronting	Picture Story
B14	Firemen	/ˈfaɪəɹmən/	/ʌmbəmən/	N/A	
B15	Daughter	/ˈdɔdəɹ/	/ ɔzəɹ/	Initial consonant deletion, fricative replaces stop	
B16	Sisters	/ˈsɪstəɹz/	/ˈsestəlz/	Lateral approximant replaces approximant	
B17	Mother	/ˈməðə/	/məzə/	Alveolarization	
B18	Slipper	/ˈslɪpəɹ/	/sepəɹ/	Cluster reduction	
B19	Prince	/pɹɪns/	/pɹen/	Final consonant deletion	
B20	Prince	/pɹɪns/	/pɪnts/	Cluster reduction, added cluster	
B21	Breads	/bɹɛdz/	/bɛdz/	Cluster reduction	Instructions
B22	Peanut	/piˌnət/	/piˌnə/	Final consonant deletion	
B23	Jelly	/dʒɛli/	/mɛnei/	Deaffrication, assimilation	
B24	Touch	/tʌtʃ/	/təːp/	Deaffrication	Picture naming (Verbs)
B25	Cutting	/kədɪŋ/	/kʌdɪŋ/	N/A	
B26	Driving	/ˈdɹɑɪvɪŋ/	/wɑɪvɪŋ/	Cluster reduction/initial consonant deletion, gliding	
B27	Clothes	/kloʊðz/	/koʊvz/	Cluster reduction, backing of fricative	
B28	Duck	/dək/	/tʃək/	Affrication	Repetitions
B29	Flower	/ˈflaʊəɹ/	/ saʊəɹ/	Cluster reduction, Alveolarization	
B30	Pipe	/paɪp/	/peɪp/	Vowel heightening	

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
C1	Hospital	/ˈhɒspɪtəl/	/ˈhɒspɪ/	Weak syllable deletion	Questions
C2	Sunday	/ˈsənˌdeɪ/	/ˈsənˌet/	Cluster reduction, monopthongization, final consonant added	
C3	Got	/gɑt/	/fɑt/	Fronting	
C4	Soccer	/ˈsɑkəɹ/	/ˈtɑkəɹ/	Stopping	Picture Story
C5	Soccer	/ˈsɑkəɹ/	/ˈsɑktə/	Added cluster	
C6	Not	/nɑt/	/mɒt/	Labialization	
C7	Umbrella	/əmˈbɹɛlə/	/ɒpɹənə/	N/A	
C8	Boy	/bɔɪ/	/mɔɪ/	Nasal replaces stop	

C9	Umbrella	/əmˈbɹɛlə/	/bəbɹæn/	N/A	
C10	Umbrella	/əmˈbɹɛlə/	/muːˈpɹʌmblɪ/	N/A	
C11	Cat	/kæt/	/tɒk/	Vowel backing, Metathesis	
C12	Pet	/pɛt/	/pɛp/	Assimilation	
C13	Can't	/kæːnt/	/kæːns/	Fricative replaces stop	
C14	Cinderella	/sɪndəɹelə/	/sɛndɹɪn/	N/A	
C15	Clean	/kliːn/	/kəliːn/	Epenthesis	
C16	Bread	/bɹɛd/	/ɹɛd/	Cluster reduction	Instructions
C17	Bread	/bɹɛd/	/bɹɛnd/	Added cluster	
C18	Peanut	/ˈpiˌnət/	/ˈpiˌnə/	Final consonant deletion	
C19	Peanut	/ˈpiˌnət/	/ˈpiˌtə/	Metathesis, final consonant deletion	
C20	House	/haʊs/	/haʊ/	Final consonant deletion	Picture naming (Nouns)
C21	Beaver	/ˈbivəɹ/	/ˈbiːðiː/	Backing of fricative, assimilation	
C22	Beaver	/ˈbivəɹ/	/ˈbiːbɹə/	Assimilation, metathesis	
C23	Hammock	/ˈhæmək/	/ˈhæpək/	Labialization	
C24	Pallet	/ˈpælət/	/ˈpæləʊ/	Diphthongization, final consonant deletion	
C25	Touch	/tətʃ/	/pʌθ/	Labialization, Coalescence	Picture naming (Verbs)
C26	Barking	/ˈbɑːkɪŋ/	/ˈbɒkɪŋ/	N/A	
C27	Duck	/dək/	/gək/	Backing	Repetitions
C28	Bird	/bəɹd/	/bʌd/	Cluster reduction	
C29	Food	/fud/	/buːd/	Stopping	
C30	Train	/tɹaɪn/	/tɹen/	Monopthongization	
C31	Pipe	/paɪp/	/aɪp/	Initial consonant deletion	
C32	Fan	/fæn/	/hæn/	Backing of fricative	
C33	Bus	/bəs/	/bəʊs/	Diphthongization	
C34	Town	/taʊn/	/təʊn/	Vowel centralizing	
C35	Chased	/tʃeɪst/	/kleɪst/	Deaffrication	

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
D1	Little	/ˈlɪdəl/	/ˈlɪl/	N/A	Questions
D2	Mom	/mɑm/	/mɑn/	Alveolarization	
D3	Rain	/ɹeɪn/	/vɹeɪn/	Initial consonant added	Picture Story
D4	Umbrella	/əmˈbɹɛlə/	/ɹælæ/	Weak Syllable deletion, initial consonant deletion, vowel assimilation	
D5	Tricycle	/ˈtɹaɪsɪkəl/	/tɹaɪkəl/	Weak syllable deletion	

D6	Act	/ækt/	/æpt/	Labialization	
D7	Toothbrush	/tuːθbɹʌʃ/	/tuːsbɹʌʃ/	Alveolarization	Picture Naming (Nouns)
D8	Cactus	/ˈkæktəs/	/ˈkætˈkæt/	Cluster reduction, reduplication	
D9	Hammock	/ˈhæmək/	/ˈhæmət/	Fronting	
D10	Stethoscope	/ˈstɛθəˌskɑʊp/	/ˈstɛsəˌskɑʊp/	Cluster reduction, alveolarization	
D11	Shivering	/ˈʃɪvəɹɪŋ/	/ˈʃɪvɪŋ/	Weak syllable deletion	Picture Naming (Verbs)

The following tables consist of all misproductions from Patients with Anomic aphasia.

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
E1	Problem	/ˈpɹɑbləm/	/ˈpɑbɹəm/	Cluster reduction	Questions
E2	Lung	/ləŋ/	/lʌŋ/	N/A	
E3	Removed	/ɹəˈmuvd/	/fɹiːmuvd/	Initial consonant added	
E4	Quarters	/ˈkwɔrtərz/	/fɔrtərz/	Cluster reduction	
E5	Talking	/ˈtɔːkɪŋ/	/ˈkɔːkɪŋ/	Backing	
E6	That	/ðæt/	/jæt/	Affrication	
E7	Problem	/ˈpɹɑbləm/	/fɹɑbləm/	Fricative replaces stop	
E8	That’s	/ðæts/	/dæts/	Stopping	
E9	Twenty	/ˈtwɛnti/	/ˈtuːnti/	Cluster reduction, Vowel backing	
E10	January	/ˈdʒænjəˌwɛɹi/	/ˈdʒænjuwɛɹɪɛɹɪ/	Reduplication	
E11	Problems	/ˈpɹɑbləmz/	/ˈpɑbləmz/	Cluster reduction	
E12	Problem	/ˈpɹɑbləm/	/ˈpɑbləm/	Cluster reduction	
E13	Woman	/ˈwʊmən/	/ˈwʊmə/	Final consonant deletion	
E14	Start	/stæɹt/	/sæɹt/	Cluster reduction	
E15	Divorce	/dɪˈvɔːs/	/vɪˈvɔːs/	Assimilation	
E16	Very	/ˈvɛɹi/	/ˈvɛvi/	Assimilation	
E17	Read	/rɛd/	/jɛd/	Gliding	
E18	Newspaper	/ˈnjuzˌpeɪpəɹ/	/ðuːzˌpepəɹ/	Denasalization, cluster reduction, monopthongization	
E19	Came	/keɪm/	/teɪm/	Fronting	
E20	Umbrella	/əmˈbɹɛlə/	/əɹɛlə/	Weak syllable deletion, initial consonant	Picture Story

				deletion, Epenthesis	
E21	Ice	/aɪs/	/aɪp/	Stopping	
E22	Overboard	/əʊvəɹbɔːɹd/	/əʊvəfɔːɹd/	Assimilation	
E23	Don't	/doʊnt/	/noʊnt/	Assimilation	
E24	Going	/ˈgəʊɪŋ/	/ˈkəʊɪŋ/	Devoicing	
E25	Slipper	/ˈslɪpəɹ/	/ˈsɪsəp/	Cluster reduction, assimilation,	
E26	Toothbrush	/tuːθbɹʌʃ/	/tuːsbɹʌʃ/	Alveolarization	Picture Naming (Nouns)
E27	Octopus	/ˈɑktəpəs/	/ˈɑptəʊpəs/	Assimilation	
E28	Cactus	/ˈkæktəs/	/ˈdʒæktəs/	Affrication	
E29	Stethoscope	/ˈstɛθəˌskɑʊp/	/ˈsɛsəɹˌsəʊ/	Cluster reduction, alveolarization, cluster reduction, final consonant deletion	
E30	Train	/tɹeɪn/	/tɹeɪd/	Denasalization	Repetitions
E31	Globe	/gləʊb/	/gəʊb/	Cluster reduction	
E32	House	/haʊs/	/haʊp/	Stopping	
E33	Queen	/kwiːn/	/triːn/	Alveolarization	
E34	In	/ɪn/	/ɪ/	Final consonant deletion	
E35	Tour	/tʊəɹ/	/kʊəɹ/	Backing	
E36	Cat	/kæt/	/tæt/	Fronting	
E37	Worm	/wəɹm/	/vəɹm/	Fricative replaces approximant	
E38	Repeat	/ɹiˈpit/	/ɹiˈbit/	Voicing	
E39	Smelled	/smɛləd/	/sbɛlz/	Denasalization, final consonant deletion, fricative replaces stop	
E40	Repeat	/ɹiˈpit/	/ɹiˈbit/	Voicing	
E41	Boy	/bɔɪ/	/dɔɪ/	Alveolarization	
E42	Clawed	/klɔːd/	/sɔːd/	Fricative replaces stop, cluster reduction	

No	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
F1	Slow	/sləʊ/	/səʊ/	Cluster reduction	Questions
F2	Before	/bəˈfɔəɹ/	/fɔə/	Weak syllable deletion	
F3	Spurts	/spəɹts/	/fəɹts/	Labiodentalization, cluster reduction	

F4	Sometimes	/ˈsʌmtɑɪmz/	/’nɒdɑɪmz/	Nasal replaces fricative, cluster reduction, voicing	
F5	Seem	/si:m/	/fli:m/	Labiodentalization, added cluster	
F6	Came	/keɪm/	/teɪm/	Fronting	
F7	Call	/kɔl/	/tɔl/	Fronting	
F8	Transferred	/tɹansˈfə:d/	/tansˈfə:d/	Cluster reduction	
F9	Was	/wəz/	/əz/	Initial consonant deletion	
F10	Rain	/ɹeɪn/	/weɪn/	Gliding	
F11	Mother	/ˈməðəɹ /	/ˈməwə/	Lateral approximant replaces fricative	
F12	Ladders	/ˈlædəɹz/	/ˈlæləz/	Assimilation	
F13	Daughter	/ˈdɔdəɹ/	/ˈdɔɹəɹ/	Assimilation	
F14	Grandmother	/ˈgɹændˌməðəɹ/	/ˈzænˌməðə/	Cluster reduction, fricative replaces stop	
F15	Jelly	/ˈdʒɛli/	/ˈdɛli/	Deaffrication	Instructions
F16	Toothbrush	/tu:θbɹʌʃ/	/du:θbɹʌʃ/	Voicing	Picture Naming (Nouns)
F17	Bench	/bɛnʃ/	/bɛʃ/	Cluster reduction	
F18	Cactus	/ˈkæktəs/	/ˈgæktəs/	Voicing	
F19	Stethoscope	/ˈstɛθəˌskɑʊp/	/ˈsɛsəˌkɑʊp/	Cluster reduction, alveolarization, cluster reduction	
F20	Sphinx	/sfɪŋks/	/sɪŋks/	Cluster reduction	
F21	Pallet	/ˈpælət/	/ˈbælət/	Voicing	
F22	Shivering	/ˈʃɪvəɹɪŋ/	/ʒɪvəɹɪŋ/	Voicing	Picture Naming (Verbs)
F23	Shaving	/ˈʃeɪvɪŋ/	/ˈseɪvɪŋ/	Alveolarization	
F24	Sock	/sɑk/	/dɑk/	Stopping	Repetitions
F25	Jail	/dʒeɪl/	/deɪl/	Deaffrication	
F26	Jail	/dʒeɪl/	/deɪl/	Deaffrication	
F27	Pipe	/paɪp/	/baɪp/	Voicing	
F28	Can	/kæ:n/	/æ:n/	Initial consonant deletion	
F29	Pick	/pɪk/	/bɪk/	Voicing	
F30	From	/fɹəm/	/pəm/	Stopping, cluster reduction	
F31	Hotel	/həʊˈtɛl/	/pəʊˈtɛl/	Stopping	
F32	Cat	/kæt/	/gæt/	Voicing	
F33	Caught	/kɔt/	/gɔt/	Voicing	
F34	Children	/ˈtʃɪldɹ ən/	/dɪldɹ ən/	Deaffrication	
F35	Smelled	/smɛləd/	/mɛləd/	Cluster reduction	
F36	Weather	/ˈwɛðəɹ/	/ˈwɛləɹ/	Alveolarization	

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
G1	Every	/ˈɛvəɹi/	/ˈəvəɹi/	Assimilation	Questions
G2	Would	/wʊd/	/wuː/	Vowel backing, final consonant deletion	
G3	Very	/ˈvɛɹi/	/ˈwɛɹi/	Lateral approximant replaces fricative	Picture Story
G4	Erase	/ɪˈɹeɪz/	/ɹiːˈeɪs/	Metathesis	
G5	Still	/stɪl/	/stɪlz/	Added cluster, added final consonant	
G6	Runs	/ɹənz/	/wənz/	Gliding	
G7	Sock	/sɑk/	/nɑk/	Nasal replaces fricative	Repetitions
G8	Globe	/gləʊb/	/gələʊb/	Epenthesis	
G9	Truck	/tɹək/	/dək/	Cluster reduction, voicing	
G10	The	/ðə/	/də/	Stopping	
G11	Caused	/kɔːzəd/	/gɔːzəd/	Voicing	
G12	Volcano	/vɑlˈkeɪnəʊ/	/ɑlˈkeɪnəʊ/	Initial consonant deletion	Picture Naming (Nouns)
G13	Stethoscope	/ˈstɛθəˌskɑʊp/	/skɑʊp/	Weak syllable deletion, weak syllable deletion	
G14	Stethoscope	/ˈstɛθəˌskɑʊp/	/ˈstɛθskɑʊp/	Weak syllable deletion	
G15	Unicorn	/ˈjuːnɪkɔːn/	/ˈjuːkɔːn/	Weak syllable deletion	

	Word	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
H1	Speaking	/ˈspiːkɪŋ/	/ˈspiːtʃɪŋ/	Affrication	Questions
H2	Stroke	/stɹoʊk/	/stɹɒk/	Monopthongization	
H3	That	/ðæt/	/æt/	Initial consonant deletion	
H4	Rehabilitation	/ˌɹihəˌbɪliˈteɪʃən/	/ˌɹihəˌbəleɪs/	N/A	
H5	Crap	/kɹæp/	/kɹæpələ/	N/A	
H6	Book	/bʊk/	/bɜːk/	Vowel fronting	
H7	Math	/mæθ/	/mæθɪŋə/	N/A	
H8	Sisters	/ˈsɪstəɹz/	/ˈstɪsəɹz/	Metathesis	Picture Story
H9	Outfit	/ˈɑʊtˌfɪt/	/ˈɑʊɹəmɪt/	Approximant replaces stop,	

				epenthesis, nasal replaces fricative	
H10	Spread	/spɹɛd/	/splɛdʒ /	Lateral approximant replaces approximant, affrication	Instructions
H11	Bench	/bɛnʃ/	/bɹænʃ/	Added cluster, vowel lowering	Picture Naming (Nouns)
H12	Volcano	/vɑlˈkeɪnoʊ/	/vɑlkiːdoʊ/	Monopthongization, Denasalization	
H13	Cactus	/ˈkæktəs/	/ˈkætʃkuːs/	Affrication, metathesis, vowel heightening	
H14	Hammock	/ˈhæmək/	/ˈsæmək/	Fronting of fricative	
H15	Stethoscope	/ˈstɛθəˌskɑʊp/	/ˈstɛtʃəˌskɑʊp/	Affrication	
H16	Ball	/bɔl/	/bɔg/	Stopping	Picture Naming (Verbs)
H17	Scratching	/ˈskɹatʃɪŋ/	/ˈskɹʌtʃənɪŋ/	Vowel backing, epenthesis	
H18	Globe	/gloʊb/	/loʊb/	Initial consonant deletion	Repetitions
H19	Vest	/vɛst/	/bez/	Stopping, voicing, cluster reduction	
H20	Book	/bʊk/	/bʊd/	Fronting	
H21	Cream	/kɹim/	/kɹuːm/	Vowel backing	

The following tables consist of all Patients with Wernicke's Aphasia.

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
I1	Cactus	/ˈkæktəs/	/ˈkækts/	Weak syllable deletion	Picture Naming (Nouns)
I2	Hammock	/ˈhæməkˈ/	/ˈkæməp/	Stopping, labialization	
I3	Stethoscope	/ˈstɛθəˌskɑʊp/	/ˈsɛθəˌskɑʊp/	Cluster reduction	
I4	Unicorn	/ˈjuːnɪkɔːn/	/ˈjuːnɪkəʊn/	Diphthongization	
I5	Sphinx	/sfɪŋks/	/θɪŋks/	Coalescence	
I6	Pallet	/ˈpælət/	/ˈpɑʊlət/	Diphthongization	
I7	Flower	/ˈflaʊəɹ/	/ˈfləʊəɹ/	Vowel centralizing	Repetitions
I8	Food	/fud/	/fluːd/	Added cluster	
I9	Sock	/sɑk/	/uːk/	Initial consonant deletion, vowel heightening	
I10	Train	/tɹeɪn/	/kweɪn/	Backing, gliding	
I11	Basket	/ˈbaskɪt/	/ˈbasɪs/	Cluster reduction, assimilation	
I12	Pipe	/paɪp/	/paɪk/	Velar replaces bilabial	
I13	Movie	/ˈmuvi/	/ˈmuzi/	Alveolarization	

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
J1	Better	/ˈbɛdər/	/ˈbɛgə/	Backing	Questions
J2	Ambulance	/ˈæmbjʊləns/	/pipələns/	Added initial consonant, vowel heightening, devoicing, assimilation	
J3	Shove	/ʃəv/	/ʃəŋ/	Nasal replaces fricative	
J4	Walking	/ˈwɔkɪŋ/	/ˈkwɔkɪŋ/	Added cluster	
J5	Someone	/ˈsəmˌwən/	/ˈsəmˌlən/	Lateral approximant replaces approximant	
J6	We	/wi/	/vi/	Fricative replaces approximant	
J7	Present	/ˈprɛzənt/	/ˈprɛzəld/	Denasalization, voicing	Picture naming (Verbs)

No.	*Word*	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
K1	Speech	/spitʃ/	/spetʃ/	Vowel lowering	Questions
K2	Things	/θɪŋz/	/θɹɪŋz/	Added cluster	
K3	Umbrella	/əmˈbɹɛlə/	/plʌðə/	N/A	
K4	Potato	/pəˈteɪdoʊ/	/pəˈteɪnə/	Nasal replaces stop, assimilation	Instructions
K5	liked	/laɪkt/	/haɪkəd/	Fricative replaces lateral approximant	Repetitions
K6	Sock	/sɑk/	/swɑk/	Added cluster	
K7	Sock	/sɑk/	/fɑk/	Fronting of fricative	
K8	Globe	/gloʊb/	/ɹoʊb/	Coalescence	
K9	House	/haʊs/	/haʊf/	Fronting of fricative	
K10	Feather	/ˈfɛðəɹ/	/ˈfɛdəɹ/	Stopping	
K11	Tree	/tɹi/	/tɹeɪ/	Diphthongization	
K12	Listening	/ˈlɪsənɪŋ/	/ˈlɪθɪŋ/	Affrication, Weak syllable deletion	Picture Naming (Verbs)
K13	Shivering	/ˈʃɪvəɹɪŋ/	/ dʒɪvəɹɪŋ/	Affrication	
K14	Catch	/kɛtʃ/	/kæd/	Vowel lowering, Deaffrication	
K15	Time	/taɪm/	/haɪm/	Fricative replaces stop	
K16	House	/haʊs/	/haʊ/	Final consonant deletion	Picture Naming (Nouns)
K17	Octopus	/ˈɑktəpəs/	/ˈɑktəwəs/	Approximant replaces stop	
K18	Cactus	/ˈkæktəs/	/ˈkæləs/	Lateral approximant replaces stop	

	Word	*Target Pronunciation*	*Actual Pronunciation*	*Phonological Error Pattern(s)*	*Activity*
L1	Situation	/sɪtjuːˈeɪʃən/	/sɪtʃjuːˈɪʃən/	Monopthongization	Questions
L2	Ago	/əˈgɑʊ/	/əˈgeɪ/	Vowel fronting	
L3	Harder	/ˈhɑɹdəɹ/	/ˈhɑːdiː/	Vowel fronting	
L4	Harder	/ˈhɑɹdəɹ/	/ˈhɑːdiː/	Vowel fronting	
L5	Fabulous	/ˈfabjʊləs/	/ˈfabʊləs/	Cluster reduction	
L6	Worked	/wəɹkt/	/wəɹd/	Cluster reduction, voicing	
L7	Worked	/wəɹkt/	/wəɹd/	Cluster reduction, voicing	
L8	Playing	/ˈpleɪ’ɪŋ/	/ˈpeɪ’ɪŋ/	Cluster reduction	Picture Story
L9	Kicked	/kɪkəd/	/pɪkəd/	Assimilation	
L10	Helping	/ˈhɛlpɪŋ/	/ˈhæpɪŋ/	Cluster reduction, vowel lowering	
L11	Here	/hɪəɹ/	/hiːl/	Monopthongization	
L12	Meet	/mit/	/niːt/	Alveolarization	

L13	Leave	/liv/	/liːz/	Alveolarization	
L14	Peek	/pik/	/pit/	Fronting	
L15	Saying	/ˈseɪɪŋ/	/ˈsɑɪŋ/	Monopthongization	Instructions
L16	Both	/bəʊθ/	/bəʊs/	Alveolarization	