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Pay Attention: A Labovian Study into the Production of Dental Fricatives by German Speakers of English

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Abstract. This study draws on research in areas of intraspeaker variation, specifically Labov's work on speech style, and second language acquisition, to examine whether second language (L2) speakers of English follow similar patterns of intraspeaker variation as a function of formality as first language (L1) speakers of English. The participants were five female university students or recent graduates who all shared German as L1 and English as L2. The sociolinguistic interview method was adopted from Labov's work to elicit speech samples from participants in four different contexts ranging from least formal to most formal, beginning with a casual interview stage, moving to reading aloud a short passage, a list of words in isolation, and finishing with a list of minimal pairs which contrasted the target sound, dental fricatives, with phonetically-similar sounds. These voice recordings were then auditorily and acoustically analysed to find which speech contexts yielded the most standard productions, showing that, similarly to L1 speakers, L2 speakers show a positive correlation between the formality of the context and the amount of attention paid to speech and the frequency of standard productions. Additionally, it was also found that in situations where other sounds were used as replacements for the dental fricative, voiced alveolar plosives replaced voiced dental fricatives and voiceless labiodental fricatives replaced the voiceless dental fricatives in all cases except those in which coarticulation occurred. The implications of this study are far-reaching, demonstrating crossover research is much needed in the areas of L2 acquisition and L2 users' speech patterns.

Plain English Abstract. Labov's (1966) seminal work on speech style proposed that the attention paid to speech and the formality of the speech context affect how a speaker uses language. His original findings showed that speakers changed the way they spoke to include more standard speech sounds in more formal contexts, where most attention was paid to speech. This study investigates whether this model is applicable to a second language (L2) speech context. L2 speech research has shown that the perception of L2 speech sounds is influenced by the speaker's first language (L1) (Flege, 1995) and as a consequence, L2 speakers often replace certain L2 sounds by similar L1 categories. I hypothesised that L2 German speakers would use more dental fricatives in more formal styles, where most attention was paid to speech, and more sound replacements, e.g., labiodental fricatives, in more informal contexts. I used the sociolinguistic interview to elicit data from five German speakers of English in four speech styles (casual, passage reading, isolated words, minimal pairs). The target phonemes were the English dental fricatives /θ ð/, typically realised as voiced in words such as 'then', and as voiceless in words such as 'thumb' in many varieties of English. Results confirmed the hypothesis, showing that participants used fewer instances of dental fricatives in the more casual speech styles, using more replacement sounds instead, and more instances of dental fricatives in the more formal speech contexts. These findings provide a basis for further investigation in L2 style-shifting, and potential changes in L2 teaching.

Keywords: dental fricatives; language variation; second language speech learning; sociolinguistics; speech style; L2 style-shifting

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1 Introduction

Language is a key aspect of humanity, enabling communication and bonding, connecting people, and forming the basis of identities. While speaking one language is seen as a basic human ability, the number of people speaking two or more languages is rising and it is thought that, globally, the number of multilingual speakers far overwhelms the number of monolingual speakers (Tucker, 1999): moreover, Ansaldo et al. (2008) make the case that over 50% of the world's population are bilingual. The number

of English speakers is thought to be over two billion, a combination of both L1 and L2 speakers of English, making it the most widely used language worldwide (Crystal, 2004). This number is rapidly growing each day, with people often seeing having English as a second language as being a necessary skill in areas of life such as travelling or working, as it can often be used as a lingua franca between different first language speakers.

There is a wealth of research into the factors which influence L2 speech production, examining causes such as motivation to learn the language, the age of acquisition, or interference from the first language. Models of speech perception and production of L1 speech can be mapped onto L2 learning, such as Flege's Speech Learning Model (SLM), Best's Perceptual Assimilation Model (PAM, PAM-L2), or Iverson and colleagues' Perceptual Interference Account (PIA), in attempts to explain some of the causes of a foreign accent (Flege, 1995; Iverson et al., 2003; Best & Tyler, 2007; Tyler, 2019). However, L2 speech is not only affected in terms of production and pronunciation, but may also be influenced by social factors. One such area within sociophonetics is intraspeaker variation; research in this area has shown how a person's speech changes as a result of external factors, such as audience or the formality of the speech context. In those more formal situations, more attention is paid to speech, an idea which has been the topic of much of Labov's work (1966; 1972), investigating how attention paid to speech affects the production of speech.

There has been little research into the overlap of second language acquisition (SLA) and this type of intraspeaker variation; however, an interesting question to pose is whether L2 speakers' variation follows a similar pattern to that of L1 English speakers, and whether subsequent analysis of this variation reveals patterns of replacement sounds expected from the models of speech perception and production. As Labov's work formed foundations in understanding how phonetic variables are linked to social categories, since then, many researchers have used this work as a basis for delving further into analysing the relations between speech and social context, particularly the ways in which speakers construct different personas in different contexts. For this reason, it seemed appropriate to use a first wave, Labovian approach to investigating L2 speakers, as these are an under-researched population in sociophonetics, meaning that this can be used as a starting point for further research into L2 speakers and contextual presentations. The first section of this work will review the existing literature relating to both SLA and intraspeaker variation, before outlining the study methodology, analysis, and results, concluding with a discussion of these results in relation to the relevant literature.

2 Literature Review

2.1 First Language Acquisition and the Critical Period Hypothesis

Before SLA can begin to be explored, its background in first language acquisition (FLA) must first be established. FLA is a broad area of linguistics, covering topics from morphology to lexicology and phonology, and within the Critical Period Hypothesis (CPH), first proposed in Speech and Brain Mechanisms (Penfield & Roberts, 1959) but popularised later on by Lenneberg (1967). The foundations of the CPH advocate that there is a biological time period in which speech must be acquired, and after that time it may become very difficult or even near impossible to do; Lenneberg's original theory posed that 'basic skills not acquired by [the end of the critical period] usually remain deficient for life' (Lenneberg, 1967, p. 158). There is indeed evidence from cases of children with limited or no language exposure evidencing that if there is a severe lack of input, then language abilities do not develop (Curtiss, 1977; Hoff, 2004; Aitchison, 2008; Brooks & Kempe, 2012). However, a large part of the dispute surrounding the CPH is that if it is assumed to exist, there is no clearly-definable end period.

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Some argue that there are 'different critical periods for different language skills' (Genetti, 2014, p. 354), such as morphology, syntax, or phonology, and for SLA this would mean that if a speaker learning an L2 had not acquired the phonology of the L2 by the end of the hypothesised specific critical period, then they would be unable to do so. Thompson (1991) explored this in a study into the pronunciation of English by Russian immigrants, hypothesising that the age of acquisition of English would be the 'strongest predictor of the accuracy of their pronunciation' (Thompson, 1991, p. 184). This study involved Russian adults who had emigrated to the U.S. at different ages having their speech recorded on three different tasks; sentence reading, with sentences containing sounds 'known to be difficult for Russian speakers to pronounce' (Thompson, 1991, p. 185); passage reading, with this speech middling between sentences and casual speech; and spontaneous speech, where participants were asked to speak for a minute on their day thus far. These speech samples were rated by two groups of listeners, one experienced in foreign languages who had frequent contact with Russian speakers and one inexperienced group who had little to no knowledge of foreign languages or L2 speakers. These groups were asked to rate how accented the speech of the Russian speakers seemed in each of the sample contexts, and they found that the age of arrival to the U.S. — and therefore the earlier or later age of acquisition — was the biggest indicator into how accented their L2 speech was perceived to be (Thompson, 1991).

2.2 Models of Speech Production and Perception

The existence of a critical period for language learning also has evidence against it; this evidence includes the aforementioned debate about the undefined cut-off period before which language must be learned, making it difficult for evidence supporting it to be much more than speculation. Additionally, there is evidence that L2 learning can continue after the proposed ages for the end of the critical period into adulthood, and while there is a decline in performance on grammaticality judgement tasks (Birdsong & Molis, 2001), a maturational account such as the CPH does not predict the linear relation between age and accuracy. For this reason, the CPH has largely been overshadowed by other theories which have risen from further research into speech perception. One of these ideas, as raised by Thompson, is that L1 has a greater effect on the production of L2 than may have been first considered. Flege's SLM is based upon this idea that 'interference from the L1' (Flege, 1995, p. 235) is the leading phonological cause of a foreign accent for speakers of an L2. Flege proposes this being a result of sounds from the L1 replacing those of the L2 in production, even when they 'differ phonologically' (Flege, 1995, p. 235). He posits that a foreign accent is caused by a lack of ability to perceive L2 sounds differing from those in the L1 as speech perception becomes 'attuned to the contrastive phonic elements of the L1' (Flege, 1995, p. 238), which in turn constrains the ability to produce these different sounds.

Piske et al. (2001) examined the different factors which could affect the degree of a foreign accent in L2 speakers, using a delayed repetition technique to elicit three spoken sentences from participants. These were played to a group of raters, who were then asked to indicate on a scale from one to nine how strong a foreign accent they perceived the participants as having. They found that the speakers rated as having closest to no foreign accent were those that had begun learning English as children and had a low use of their L1, followed by those that had begun learning English as children but maintained high use of their L1. Those that had begun learning English later in life with low use of their L1 were third, and those perceived as having the strongest foreign accent were the participants who learned English later and still frequently used their L1. Piske et al.'s findings support one of the hypotheses of the SLM in showing that there is a negative correlation between age and ability to perceive phonetic differences, and that this in turn limits the ability to produce differing sounds in the L2, leading to more accented speech in both of the late bilingual categories.

In turn, PAM (Best, 1994) builds on this categorical perception work and aims to account for the ways in which naive listeners, those who are unfamiliar with a language, perceive non-native speech sounds. This model theorises that when listening to an unfamiliar phonetic segment, naive listeners will assimilate the sound to be one heard in their native language that they are familiar with, one which has similar 'articulatory-gestural' properties (Best, 1994, p. 190). It is predicted that listeners will not be able to perceive discrepancies in unfamiliar non-native sounds when these phones have similarities to those found in the phonemic catalogue of the native language, meaning that the sounds will be assimilated to the most similar familiar phone. When this is the case, these sounds are categorised as 'good, acceptable, or poor instance[s]' (Tyler, 2019, p. 610) of native phones. If the listener is able to perceive discrepancies between the sounds, this is thought to be a result of them finding a lack of similarities between the 'articulatory-gestural' properties and the non-native sound will not be assimilated; these are uncategorised sounds, those that are not perceived to be part of the native inventory. As the PAM is concerned with native speakers' perception of non-native sounds, Best and Tyler (2007) proposed the PAM-L2 model which mapped the original PAM projections to SLA to predict how L2 learners would acquire the unfamiliar sound categories when learning the L2. This is explained in terms of how if an L2 learner perceives contrasting phones as being part of different L1 sound categories, they form new categories to learn the L2 with using their knowledge of said categories from the L1. However, the PAM-L2 model has its limitations in that it is only focused on the perception of familiar vs. non-native sounds, rather than perception and production as in the SLM, and that it does not go further than the beginnings of learning a language to explain how these perceptual assimilation categories may affect L2 competency.

Iverson et al. (2003) build on Best and Flege's work on non-native speech perception to form the basis of the PIA, which also uses theories of first language acquisition to explain L2 speech perception. It is widely believed that individuals are born with the ability to acquire any language (e.g., Eimas et al., 1971; Werker & Tees, 1984) but that from language exposure these abilities become language-specific (Kuhl, 1992; 1994; Kuhl et al., 2008). The PIA posits that this language-specific perception interferes with low levels of speech processing, exemplified in the study involving Japanese and German L2 speakers of American English, and native speakers. For this study, /ra/-/la/ tokens were used: these are sounds known to be difficult to Japanese learners of English, while German learners are not known to have problems with these. Participants were given a number of tasks to determine their perception of each sound in the stimulus pair. These results were then analysed to investigate the underlying perceptual spaces of each group of participants. It was found that these were dependant on language experience, and that the American native English speakers were the most sensitive discriminatorily to the differences between the /r/ and /l/ phones, the German listeners' perceptions were close to that of the Americans, and that the Japanese group often assimilated the stimuli into their L1 /r/ category. This appeared to differ, however, in that often the sounds presented with lower F2 frequencies were perceived to sound more like /w/. Iverson et al. concluded that for adult SLA, perceptual changes are a result of changes to linguistic processes at a higher level, but that 'lower-level perceptual processes can interfere with the adaptability' (Iverson et al., 2003, p. 54) of the higher-level processes. Consequently, it can be difficult for a speaker to produce certain sounds in an L2, as if the underlying perceptual spaces make it difficult to perceive sounds, then it must be difficult to produce them.

2.3 Intraspeaker Variation

Now that SLA has been contextualised in the theories of first language acquisition and models of both speech perception and production in L1 and L2 have been explained, it is important to consider how

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variation in L1 speech may affect variation in L2 speech. Intraspeaker variation, that is, variation within an individual's speech, has been the subject of much sociophonetic research. Factors affecting this include variation as a result of the audience, including changes as a result of the audience or the interlocutor. Bell's (1984) Audience Design theory explains intraspeaker variation as a result of who the audience or addressee of the speech is, while Accommodation Theory (Giles, 1973) focuses more on the role of the interlocutor. Both draw similar conclusions in that speech appears to change in two main ways; convergence, where speech morphs to the norms of the addressee, or divergence, where speech increases the difference between speaker and addressee. There is much evidence from sociophonetic studies that speech is varied as a result of audience (e.g., Coupland, 1980; Bell, 1984; Sharma, 2018), yet additionally there is evidence that attention paid to speech is also a strong contributing factor to intraspeaker variation. Simply put, the more attention is paid to speech, the more a person will speak in a more idealised way, using a more standard form of language or more 'prestige' variants.

Labov (1966) first used these terms to describe the way participants spoke in his study in New York City (NYC) department stores, a study which was designed to test how attention paid to speech affected the use of the [r] variable, either in the presence or absence of the postvocalic /r/ variant. At the time in NYC, the use of the postvocalic /r/ was considered prestigious, used more often by those who belonged to a higher socioeconomic class, and its absence was the typical way of speaking in New York. To test how the use of this sound correlated with both attention paid to speech and socioeconomic class, Labov extracted four instances of [r] in shops which each correlated with a different social stratification, in both the context of less attention and more attention paid to speech. He found firstly that when more attention was paid to speech, the prestigious variant, this is the presence of postvocalic /r/, was used more often than when less attention was paid to speech. Secondly, these uses also varied along with the social stratification of the store, with the shop assistants in the more socially elite store using more instances of the prestigious variant. Thus, Labov's work has demonstrated how the use of standard variants, those carrying a higher level of social prestige, with the contrasting nonstandard variants, those which have less favourable wider social connotations, vary as a result of the formality of the speech context. Those with more formality have more attention paid to speech with the inverse occurring for less formal contexts. However, it is important to note that style shifting is a nuanced phenomenon and can occur in many different ways; nonstandard or vernacular variants are produced by speakers in a range of contexts, from casual to formal, and indeed, there may be no style shifting occurring for some phonetic variables.

In order to investigate these further, Labov conducted 'sociolinguistic interviews', which were designed to elicit speech from participants in a range of formalities. Speech was procured in most formal contexts, by way of reading lists of minimal pairs and words in isolation, to more casual contexts through participants reading a short passage aloud and discussion with the interviewer, allowing for a variable to be seeded throughout the materials for analysis in a range of contexts and for it to occur spontaneously (Labov, 1972). While there is far less research into the area of variation in L2 use, there is some relevant work to note. For example, Drummond's (2010) work in Manchester, examining the ways that L2 English speakers, specifically Polish L1 speakers, acquire localised speech features they are exposed to. This study found that the L2 speakers of English did acquire accent features local to Manchester, such as the realisation of STRUT as a high back vowel, however while these findings show sociolinguistic variation in L2 speakers, the variation is a result of speakers' sense of identity, as well as geographical features altering speech in all contexts as opposed to the context affecting speech, as would be observed in intraspeaker variation.

2.4 Rationale

For this study, German speakers who have English as their L2 will be the participants, using the dental fricative as the target variable for examination. The appeal for using this variable in this study is threefold; firstly, its frequency in English allowed it to be incorporated into the materials, such as the reading passage, without the participant being aware of that being the token variable. Secondly, its rarity in other languages made it easy to identify participants with a first language that did not include this sound, specifically German, and thirdly, there are sounds similar to it in both English and German, so replacement sounds could be used in the materials, especially the minimal pairs, and by participants, while still being identifiable to answer the second research question. While production of this sound is difficult for many L2 speakers of English (e.g., Owolabi, 2012), is often the case that many native English speakers do not have this sound in their inventory either. In a phenomenon referred to as TH-fronting, dental fricatives /θ, ð/ are often replaced by the labiodental fricatives /f, v/. Despite this being commonplace in a number of English-speaking areas in the UK, the realisation of the labiodental fricative in place of the dental fricative is often stigmatised in some areas of the UK (e.g., Levon & Fox, 2014).

While there is variation in the realisation of dental fricatives, which can be related to social factors, L2 speaker production of the dental fricative as labiodental is likely explained in terms of the L2 speech perception models. These models would predict that the sounds produced instead would be those that also occur in the first language and which share similar 'articulatory-gestural' properties, and in the case of the dental fricatives /θ, ð/ it is expected that they will be assimilated to either labiodental fricatives /f, v/ or to the alveolar stops /t, d/, likely with the voiceless variants replacing the voiceless and a similar pattern for the voiced variants. The realisation of /θ/ as [d] is one also shown in a study by Rahman and Hasan (2019), in which they investigated the way Chinese L2 speakers of English produced the dental fricative sound, as it also does not exist in Chinese. A similar method was used in that they used a wordlist of thirty common English words which featured the tokens in question to elicit speech samples. Their results showed that both males and females followed similar patterns of replacement with this sound, and that it was a challenging sound to all participants. Similarly, Owolabi (2012) studied the production of dental fricatives by native Yoruba speakers who were learning English as an L2, eliciting productions through participants' reading of a passage aloud which contained sets of minimal pairs, contrasting the dental fricatives with their alveolar plosive counterparts, and finding that participants indeed struggled with production. It is predicted, based on Labov's work into speech style, that in the contexts where a speaker is paying more attention to their speech, such as in reading a list of minimal pairs, they will use more realisations of the standard variation, in this instance the dental fricative, and in the contexts where less attention is paid, such as in a casual interview, more instances of an assimilated sound will occur as a vernacular counterpart, as it would in native English speakers in different instances such as talking to friends.

This study will examine whether Labov's original hypothesis investigating this pattern of variation in L1 speakers is also seen in L2 speakers. Feagin specifies that in order to get the most casual speech, participants should be talking about 'subjects [with which] they are intimately involved' (Feagin, 2002, p. 30), meaning that in the interview to elicit casual speech participants will be asked about things such as their time at university and where they previously lived in Germany. For the purpose of the current study, the dental fricative will be considered the 'standard' variant and any other 'vernacular', non-standard sounds, which will likely be comprised of an assimilated variant of the sound, to answer two research questions. The first will examine whether speech style plays a role in the production of dental fricatives by L2 speakers of English. The second research question builds on the first and will seek to answer which sounds are used in place of the dental. It is hypothesised that the patterns of variation will follow those of L1 speakers, showing a positive correlation between the

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formality of the speech context and the number of standard sounds used, and that the nonstandard replacement sounds will be those aforementioned, either labiodental fricatives or alveolar plosives.

3 Methodology

3.1 Participants

Table 1: *Participants' demographic details.*

	Participant 1	**Participant 2**	**Participant 3**	**Participant 4**	**Participant 5**
Native language	German	German	German	German	German
Fluent languages	German, English, French, Dutch	German, English	German, English	English	German, English
Place of birth	Bonn	Baden-Wurttemberg	Stuttgart	Hamburg	Worms
Other residences, longer than six months	France, 1 year	Berlin, 7 years	n/a	Coventry, 11 years	Kent, 1 ½ years
English acquisition method(s)	In school	In school	In school, exchange programs	In school — after moving to the UK	In school
Age of English acquisition (years)	9	4	10	8	5

Five female speakers were self-selected from the student population at the University of Leeds by replying to an advert placed on a Facebook page for this demographic, and following an initial interest they were asked the following questions to ensure they met the criteria for participation: how long they had lived in Germany, at what age they had begun learning English, and at what age they moved to England (Table 1). Four were students, and a fifth (Participant 1) had just completed a Master's degree at the University of Huddersfield, working now as an anatomical pathology scientist and living in Leeds. All had been living in Germany for at least the first eight years of their lives, attending German schools where they learned English as an L2, with no participants speaking it from birth. Participant 4 reported having lost the ability to speak German, meaning that although it was the native language she grew up speaking, English was now her primary and only fluent language. One participant had moved previously to Kent in the south of England to attend a boarding school there, one and a half years before beginning at the University of Leeds, and one had moved from Germany to Coventry at the age of eight. The other three participants had moved to the country to begin university, meaning the length of time living in England was between two and 11 years. No participants reported any speech or hearing impediments or any learning difficulties. Participants were not paid for their participation.

3.2 Materials

The materials for this study were those making up the different contexts, from less formal speech with less attention paid to more formal speech with more attention paid. There were ten tokens of the dental

fricative in each context, with five voiceless and five voiced variables. In the first context, the least formal, the interview questions were open-ended enough to allow sufficient speech to find ten tokens of the dental fricatives within for analysis, but as participants were not aware at this point of the variable being investigated the questions did not encourage use of the /θ, ð/ sounds, instead they occurred naturally. In the short reading passage, although it featured ten instances of the token sound at the beginning of ten words, they did not all take the same structure or shape, as this may have made it appear less natural (Appendix One). In the next two contexts however, all the words, including the filler words in the word list and the counterparts in the minimal pair, were monosyllabic with the token sounds in the word initial position of the CVC structure (Appendices Two and Three). In the final and most formal context with the minimal pairs, there were no filler pairs as participants should be paying the most attention to their speech here, in particular if they recognise the repeated pattern of dental fricatives at the beginning of words.

Participants were interviewed in a setting in the University of Leeds that was quiet enough that the background noise did not affect the quality of the audio recordings, but somewhere where it also seemed casual enough so that they could feel comfortable having a normal conversation and did not feel as though they were under scrutiny. The audio recordings were done using an Apple iPhone 6S. Participants were taken through each context of speech from the least formal to the most formal, beginning with the interview questions and ending with the minimal pairs. The rationale for conducting the interview in this way was so that participants were not immediately aware of the target variable, as this may have influenced the way in which they used it through the rest of the interview, meaning therefore the tokens in the casual speech would be more naturalistic if they are not aware then of the target sound being analysed. The contradictory nature of investigating how speech is used when not being observed, but having to observe in order to achieve this, is a concept referred to by Labov as the Observer's Paradox (Labov, 1972). It was hoped that by beginning with the casual style, it would enable participants to feel more comfortable, and distract from the purpose of the task; this design was intended as a way of minimising the effects of the Observer's Paradox and allowing for as natural speech as possible. Additionally, in the casual interview questions, participants were asked some of the same questions, such as how their day had been and where they lived in Germany before, however other questions evolved from the responses given to participants. This meant that it was not always possible to elicit the target sounds in the same words across participants, but enough tokens were produced overall to get a sufficient amount for analysis. Lastly, they were asked to fill in a language background questionnaire (Appendix Three). The interviews consisting of all four contexts took no longer than 20 minutes.

3.3 Data Analysis

To analyse participants' realisation of the dental fricatives, both voiced and voiceless, an auditory analysis was first performed to investigate whether participants produced the forms [θ] and [ð] as in standard English, or whether they assimilated the sounds to one in the German language, previously hypothesised to be either a labiodental fricative [f], [v], or an alveolar stop, [t] or [d]. These results were coded as following:

(1) 0 – [θ] [ð] production
(2) 1 – [f] [v] production
(3) 2 – [t] [d] production
(4) 3 – other sound produced

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From this, the productions of each token in each speech context could be quantified to see the sounds that are most often replaced, the contexts which have the most replacement sounds, as well as the factors that could potentially govern the changes in these sounds' productions. The auditory analysis coding will also be used to perform a chi-square test to determine the type of correlation between the sound produced and the attention paid to speech. From the sounds identified by the auditory analysis as being fricatives, those coded as 0 or 1, centre of gravity (CoG) measurements were taken as further evidence to determine the place of articulation of these sounds. CoG measurements are useful in helping to distinguish places of articulation, as it is expected that the higher the CoG measurement in Hertz, the further forward in the mouth the sound is produced (Jongman et al., 2000); therefore, these measurements were taken to add further support to the auditory analysis. The centre of gravity measurements were performed in Praat (Boersma & Weenink, 2019). Following the method used by Jongman et al. (2000) in their study of the acoustic characteristics of English fricatives, the middle 40ms of each token fricative was used to do a CoG measurement. This timeframe was chosen so as to avoid any noise or disruption at either the beginning or end of the sound, and in cases where the sound did not last for a minimum of 40ms, the middle 20ms of the fricative production was used. In cases where the token did not last for a duration of at least 20ms, these tokens were excluded from analysis, as this was only the case in the casual speech context where there were plenty of other token productions to select. This allowed for results to be more generalisable and large discrepancies in measurement length to be excluded as a factor affecting centre of gravity results. Figures 1-5 below demonstrate the waveforms and spectrograms of participants' recorded speech in the Praat software, demonstrating both the standard (Figures 1 and 2) sound and its alternatives (Figures 3, 4, and 5). The properties of each production can be seen on each waveform; in the voiced fricative production (Figure 1), the periodic waves of the voicing can be seen followed by the aperiodic waves of the turbulent airflow, and a voicing bar in the spectrogram. In Figures 2 and 3, the voiceless fricatives show aperiodic waves on the waveform and high frequency frication in the spectrogram. As previously stated, acoustic analysis will also be used to further explore the differences between dental and labiodental fricatives, those coded as 0 or 1. The results coded as 2 were all voiced alveolar plosives, and demonstrate the features of said sounds (Figure 4) in that there is a hold phase comprised of low amplitude periodic waves followed by transient waves during the release of the sound. Figure 5 demonstrates a production that was coded as a 3, 'other', where the dental fricative sound is omitted and instead the final sound of the previous word, /n/, is used, as the words run into each other.

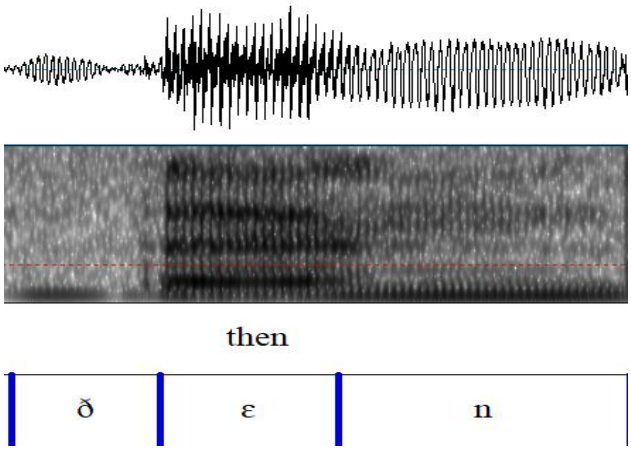

Figure 1: *Voiced dental fricative, taken from Participant 2 in the pairs condition, coded as 0.*

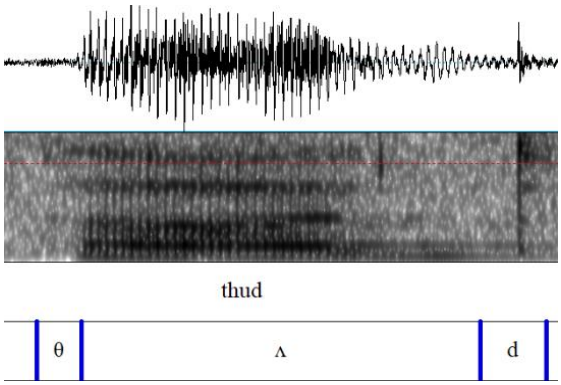

Figure 2: *Voiceless dental fricative, taken from Participant 2 in the word list condition, coded as 0.*

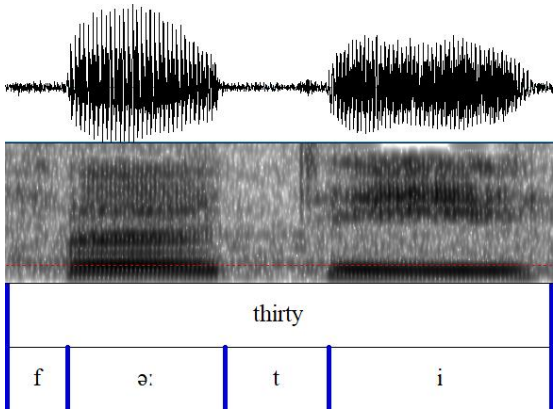

Figure 3: *Voiceless labiodental fricative, taken from Participant 1 in the reading condition, coded as 1.*

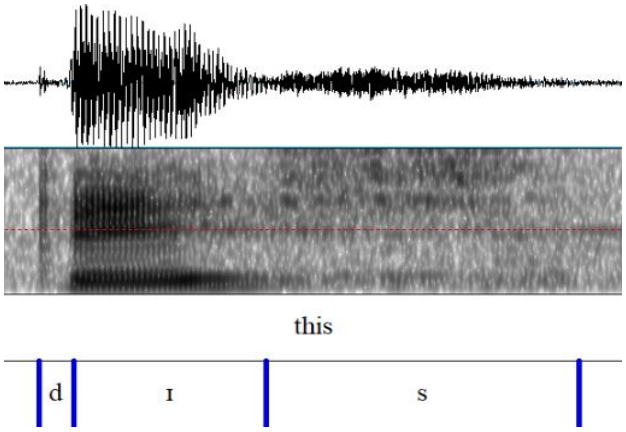

Figure 4: *Voiced alveolar plosive, taken from Participant 1 in the pairs condition, coded as 2.*

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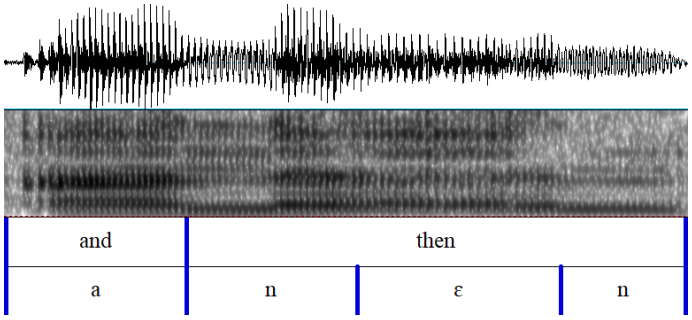

Figure 5: *Voiced alveolar nasal, taken from Participant 5 in the casual condition, coded as 3.*

4 Results

4.1 Variation as a Result of Attention Paid to Speech

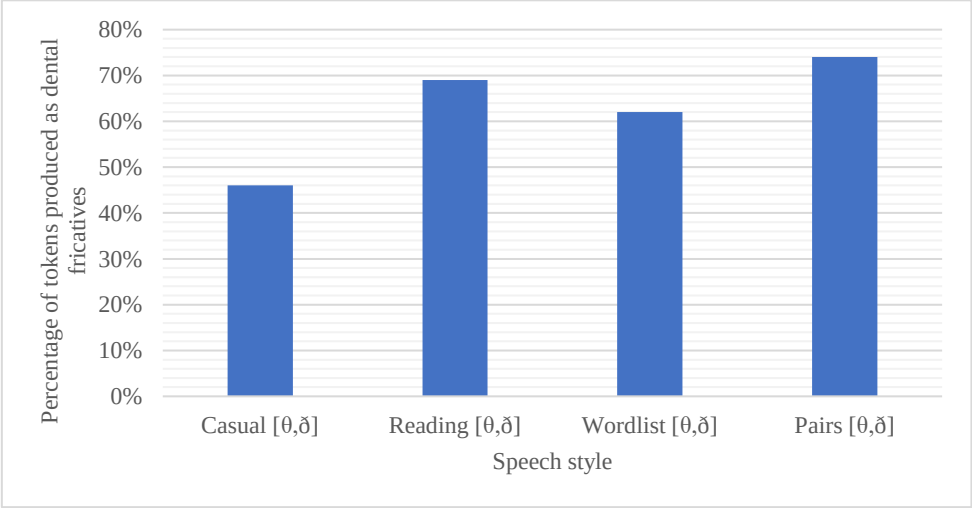

Figure 6: *The percentage of all tokens produced as standard (coded as 0) by all participants across each speech context, from least to most formal.*

In total, 415 tokens were recorded across all interviews, with 3.89% (16 tokens) of these, from the casual context only, being discarded for not meeting the criterion required for a centre of gravity measurement. This meant that 399 sounds were auditorily analysed and subsequently those that were coded as a 0 for the dental fricatives or a 1 for labiodental fricatives then had CoG measurements taken for acoustic analysis. The auditory analysis shows evidence for variation in the different tasks and speech contexts, as Figure 6 above shows the overall positive trend of the tokens produced as standard by all participants as a function of the formality of the task. The graph shows the increasing use of the standard variant in each context from least attention paid in the casual context to most attention paid in the minimal pairs context. While this is the overall trend, there is an unexpected result in the wordlist context. The coding of participants' speech in this task shows a lower number of dental fricatives being used than in the reading context, despite it being expected that the wordlist would elicit more standard productions as there is more attention paid to speech. A linear regression model has been fitted in R using dummy variables for the different contexts, shown in Table 2. The baseline context is the casual context, shown by the intercept of the model. The intercept is roughly equal to 1 and very statistically

significant, meaning the average value of the coded tokens is roughly 1. The dummy variables then test whether there is a significant difference in this average for the different contexts. The coefficient for the pairs context is significantly negative and β = -0.64, which implies the average value of the coded tokens is lower in this context, compared to the casual context. Similarly, for the reading context, a coefficient of β = -0.63 is also found, implying again that the average value for the coded tokens in this context is lower. Finally, the coefficient for the words context is less significant than the other coefficients but still significant at the 5% level (p = 0.04), and negative at β = -0.33. This means that more tokens coded as 0 were used, compared to the casual context, but fewer than the other two conditions. This supports the previous finding that the word list context is not as different from the casual context as the other speech conditions, however it still follows the same trend of having more standard tokens.

Table 2: *Linear regression output testing the significance of the difference between token usage in contexts.*

					95% Confidence Interval	
Coefficient	**Estimate**	**SD**	***t*-value**	***p* value**	**Lower**	**Upper**
Intercept	1.082	0.064	16.807	<0.001	0.955	1.209
Pairs	-0.642	0.156	-4.112	<0.001	-0.949	-0.335
Reading	-0.627	0.15	-4.18	<0.001	-0.923	-0.332
Words	-0.332	0.156	-2.062	0.0398	-0.629	-0.015
R^2	0.0705					
***F*-statistic**	9.987					
***p* value**	<0.001					

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4.2 Nonstandard Variants Used

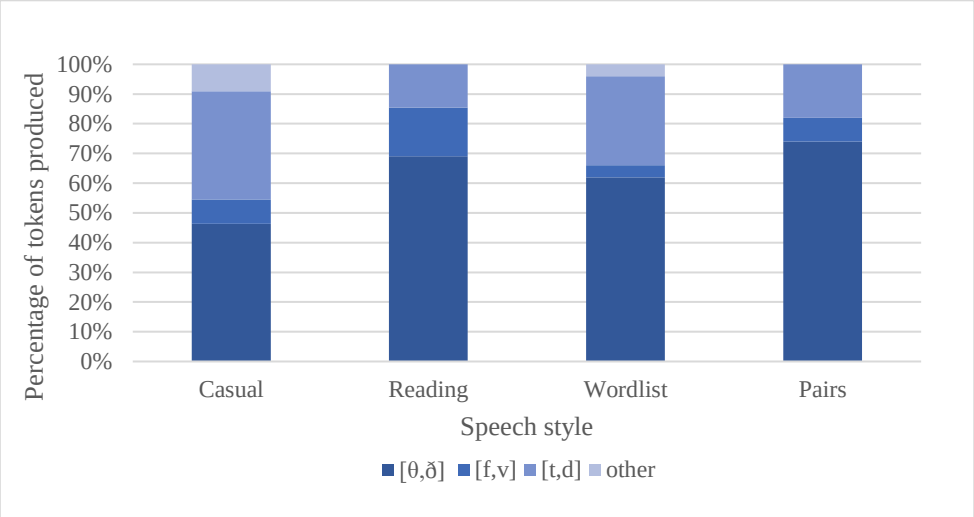

Figure 7: *The auditory analysis results from all participants in each speech context, showing the percentage realisation of each token in each speech context.*

The second research question of this study was to determine the nonstandard sounds used in cases where variation did occur. Figure 7 shows, of the nonstandard sounds produced in each context, the percentage of each variant used in place of the dental fricative. It can be seen in the casual speech context that the number of dental fricative productions almost matches the production of the alveolar stop, and accounts for less than half of the total productions. This is in contrast to the minimal pairs context, in which it is hypothesised that the most attention was paid to speech by participants, where the production of dental fricatives accounts for around three quarters of the total productions. Notably, when the sounds were coded, the labiodental fricative variants were always voiceless /f/ in place of the voiceless dental fricatives, with no voiced variant recorded in this place. The inverse was also true with the alveolar plosive sound in that the voiced variant /d/ always replaced the voiced dental fricative, and no instances of voiceless plosives replacing any standard production. Of the 399 recorded sounds retained for auditory analysis, 254 of these (63.7%) were coded as either a 0 or a 1, indicating either a dental fricative or a voiceless labiodental fricative. For the centre of gravity measurements, 203 of these sounds were long enough to use the central 40ms of the fricative, while the remaining 51 tokens had shorter fricative durations resulting in the middle 20ms of the fricative being analysed. The acoustic analysis of these tokens serves to further differentiate the fricatives produced, shown by Figure 8, a box and whisker diagram for all CoG measurements from all participants in all speech contexts, supporting the auditory analysis by demonstrating that the results coded as a 1 to represent labiodental fricatives have an average higher centre of gravity than the dental fricatives. There is not a large difference between the two mean CoG measurements, as the places of articulation are in close approximation to each other. However, there is a larger range of measurements for the dental fricatives than for the labiodental fricative, which could be a result of there being more productions of the former than the latter, meaning more variation in the productions.

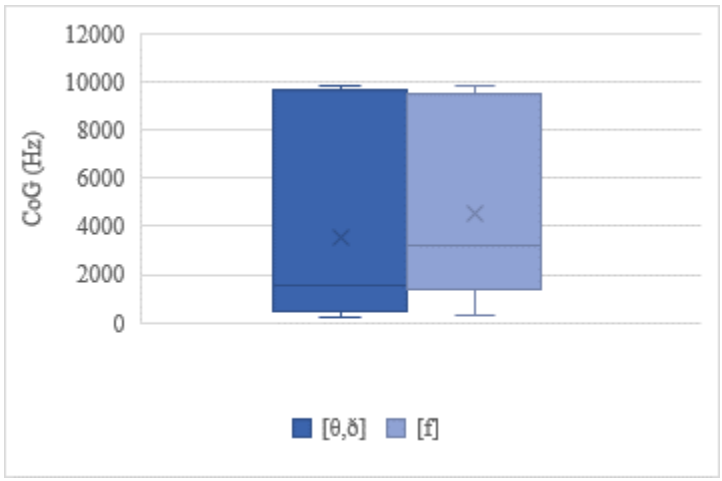

Figure 8: *Box and whisker plot showing the centre of gravity measurements for dental fricatives and the labiodental fricative [f].*

4.3 Individual Speaker Variation

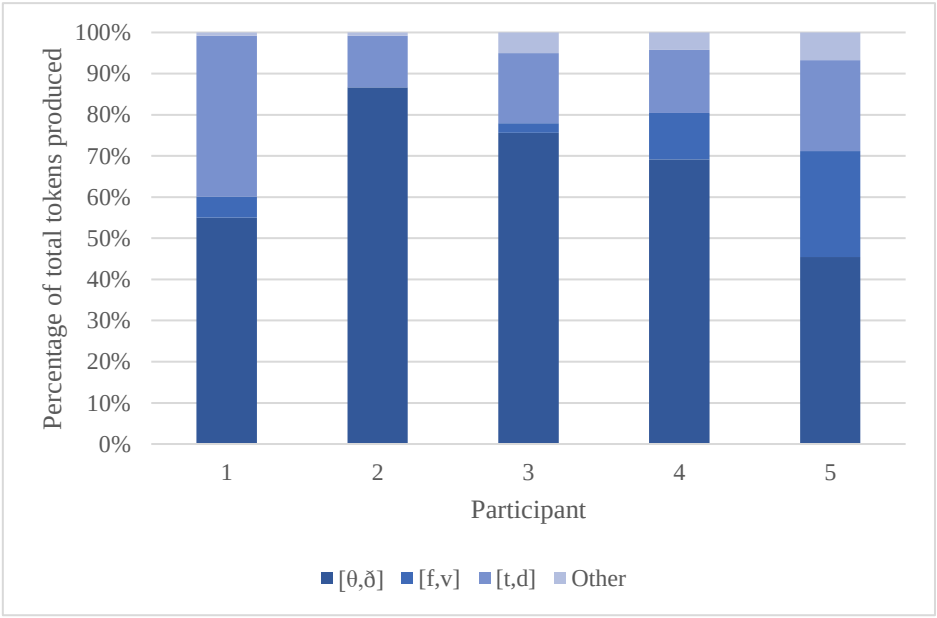

Figure 9: *Percentage of total tokens produced per participant across all speech contexts.*

Another way to interpret the results, in addition to in terms of the research questions and hypotheses, is to examine trends and variations by each participant individually. Figure 9 illustrates the productions by each participant across all speech contexts, showing that the percentage of standard productions varied greatly between participants, ranging from 45% to 87% between Participant 5 and Participant 2, respectively. As well as using the least frequent standard productions, Participant 5 used the greatest number of instances of the labiodental fricative as well as sounded coded as 'other', such as the alveolar nasal seen in Figure 5, or other unintelligible sounds. Table 3 shows the count of sounds used in each context by each participant and the variation between sounds produced in each context, as opposed to generalised across all contexts as in Figure 9.

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Table 3: *Number of tokens recorded and auditorily analysed, per participant, per condition, per realisation.*

			Participant				
			1	**2**	**3**	**4**	**5**
Condition	**Casual**	**[θ,ð]**	33	23	29	18	10
		[f,v]	2	0	0	7	11
		[t,d]	53	6	12	9	9
		Other	3	1	0	7	11
	Reading	**[θ,ð]**	7	11	9	8	3
		[f,v]	2	0	1	2	4
		[t,d]	2	0	1	1	4
		Other	0	0	0	0	0
	Words	**[θ,ð]**	6	7	9	7	5
		[f,v]	0	0	0	1	1
		[t,d]	4	3	1	2	4
		Other	0	0	0	0	0
	Pairs	**[θ,ð]**	6	10	9	9	3
		[f,v]	0	0	0	0	4
		[t,d]	4	0	1	1	3
		Other	0	0	0	0	0

5 Discussion

The aim of this study, in short, was to investigate how attention paid to speech affects intraspeaker variation in L2 speakers of English, specifically examining how the formality of speech contexts affects the production of the dental fricative by German speakers of English. A secondary research question was to determine the vernacular variants which replaced the target dental fricatives in contexts where variation did occur. The study was conducted using the Labovian sociolinguistic interview, allowing for four different contexts of speech with target sounds placed throughout. The results show that through the four speech contexts, the more attention that was paid to speech, the more standard tokens were used, and in the most casual context the most nonstandard replacements occurred, however, there was an unexpected result in that the wordlist condition elicited fewer dental fricative productions than expected. The result of the linear regression in particular showed a strong correlation between the formality of the speech context and the number of standard tokens produced by speakers.

5.1 Intraspeaker Variation in Different Speech Contexts

The first research question addressed the phenomenon of intraspeaker variation, particularly the effects of speech style on the realisation of dental fricatives by L2 speakers. Labov's original study in the New York City department stores examined the use of the postvocalic /r/ variable, noting its presence as being the 'prestigious' form of it and its absence as being the typical New York realisation. These concepts were adopted in the present study to investigate both the voiced and voiceless dental fricative, with its use being considered 'standard' and its replacement being considered 'nonstandard' or 'vernacular'. The results of this study replicate that of Labov's in L2 speech, in that the more formal speech contexts when participants paid more attention to speech – such as in minimal pairs condition in the 1972 study of NYC speech, using the sociolinguistic interview — there was more frequent use

of the variant which carried higher social connotations; in Labov's 1972 work, this was the presence of the postvocalic '/r/', and in this study the use of the dental fricative. Similarly, the results of this study mirrored others which showed an effect of different speech contexts, attention to speech, and formality on speech change, such as Sharma (2018).

While the studies appear parallel for the most part in that there is a positive association between attention paid to speech and variant use, the results of this study show an unexpected outcome: the wordlist condition elicited fewer standard productions from participants than the reading condition, despite being more formal. A potential explanation to account for this difference is that to an outsider, that is, someone who is not familiar with the format and theory behind the sociolinguistic interview, it may appear more natural to read individual words aloud, as opposed to reading out a passage to someone else. Moreover, when learning a second language, it is often the case that learners read aloud individual words in order to practice production and memorise them, while there often isn't the same opportunity to read aloud longer passages in the L2. This could be because it is not an everyday occurrence to read longer texts aloud; while there may be similar monologue style pieces in casual speech, these are more often spontaneous speech and not a pre-prepared paragraph. Additionally, work by Gafter (2016) explored the relation between different pharyngeal segments in Hebrew and their production in different speech contexts, finding that reading words in isolation had ties to cultural meanings in Hebrew speakers, and results therefore differed from the expected pattern in the word list speech context. It is difficult to say whether there were effects of either previous language learning techniques or perhaps cultural identity biases on the results of this study, and therefore, more research would be needed to determine these possible effects. A further potential factor to account for these results are that in the original study, Labov only set out to research intraspeaker variation in the L1. This could mean that the sociolinguistic interview is not necessarily equipped to measure variation in L2 use, as there may be additional factors relating to the ways in which participants utilise their L2 which were not controlled for through the use of this method.

5.2 Use of Nonstandard Sounds

As it is established that variation in L2 speakers occurs in a similar way to L1 English speakers, the results of the second research question can now be discussed. When nonstandard productions were used, the replacement sounds of the dental fricative varied. As previously seen, these sounds were subdivided into four groups from the auditory analysis; 0, for the standard sound; 1, for those which were produced as a labiodental fricative; 2, for those produced as an alveolar plosive, and 3 for any other productions. The prediction for this was that voiced dental fricatives would be replaced with either of its voiced counterparts, either the labiodental fricative or alveolar plosive, and that the voiceless standard would be likewise replaced with the voiceless nonstandard variants, as these sounds have the closest features of articulation to those which feature in the German phonological system. The results of this study show that it was not just one of these pairs used, but one sound from each of them; that is to say that it was not just labiodental fricatives replacing the dental fricative, but instead the voiceless labiodental fricative replacing the voiceless dental fricative, and the voiced alveolar plosive replacing the voiced dental fricative.

To set aside the sounds categorised as 'other', in productions where nonstandard replacement sounds occurred, in every case of the voiced dental fricative being replaced it was by the voiced alveolar plosive, and voiceless dental fricatives were replaced with voiceless labiodental fricatives. The same pattern of replacement was found in this context as in the studies by Rahman and Hasan (2019) involving Chinese speakers of English, and Owolabi's (2012) Yoruba learners of English, with the voiced fricative being replaced with the voiced alveolar plosive. While these studies did not make use

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of any other speech contexts or methods of elicitation to test patterns of variation, instead simply investigating the replacement that occurred, the results of their work parallel with this work in that the other sounds used were found to be the same, demonstrating how speakers of different native languages assimilate the unfamiliar dental fricative to the same familiar L1 sound. This further supports the predictions made by the speech perception and production models, Best's PAM (1994), Flege's SLM (1995), and Iverson's PIA (2003), in that unfamiliar sounds will be assimilated into a familiar one belonging to the L1 phonological system. There is, however, less regular replacement for the voiceless dental fricative across studies. This examination showed how it was replaced every time, still discounting the 'other' sounds, by the voiceless labiodental fricative [f], but this is not always the case; Koffi's (2015) report of the production of [θ] in seven different L2 varieties of English show it being replaced in their study sample by [t̪] 13.14% of the time, [s] 9.55% of the time and by [f] 7.76% of the time. TH-fronting, that is, replacing [θ] with [f], is a common feature in English varieties, especially British English speakers, despite carrying with it negative evaluations from listeners (e.g., Kerswill, 2003; Clark & Trousdale, 2009). Perhaps, in the context of this, the production of [f] by L2 speakers may be affected by the production of this sound in varieties of English they are exposed to, similarly to the patterns of variation in that of Drummond's (2010) work. If this were the case, it could be said that the participants in this study who produced the labiodental fricative were not replacing the sound with one which contributed to their non-native accent, but instead acquiring patterns of variation they were exposed to while learning. However, it is difficult to determine whether participants are using a replacement [f] as a sound from their L1 or whether it is related to the varieties of English they have been exposed to, hence more research would be needed in this area to investigate what governs the replacement.

Returning to the sounds categorised as 'other' through the auditory analysis, they had a range of different productions which were, in and of themselves, not enough to credit a separate category. There were two productions of the voiceless dental fricative in place of the standard voiced, which could be explained by the participant being unfamiliar with the words they were reading, despite attempts to utilise common words. The other results arose from productions where co-articulation occurred, therefore, it appeared as though the dental fricative was being replaced by the nasal stop [n] most often, or in one case by the voiceless alveolar fricative [s]. Co-articulation is the process in which the oral articulators are preparing to produce the next sound as one is already being produced (Gordon, 2014), resulting in a 'run on' effect, as seen in Figure 5 above in the production of the phrase 'and then' by Participant 5. Figure 7 shows how these 'other' sounds were most frequent in the casual speech context with less attention paid to speech and could have resulted from casual speech being faster than other speech contexts (e.g., Zwicky, 1972).

5.3 Individual Participants' Variation

Lastly, the results could also be interpreted in terms of age effects on L2 acquisition. As shown by Piske et al. (2001), there are numerous factors which could affect strength of a foreign accent, principally being the age of acquisition, with frequency of use of the L1 also factoring in. Interestingly, Participant 5, who had an age of acquisition just one year older than Participant 2, had the lowest use of nonstandard features, a divergence from the expected result. On the other end of the scale, Participant 3 had the oldest age of acquisition of English at ten years old, yet this too was not reflected in the results. Participant 3 had the second highest use of the standard dental fricative token across all speech contexts, again not showing the age effects expected, which could raise questions as to why this could be. All participants learned English in school, perhaps suggesting that the variations in standard and non-standard production is not so much a matter of the age of acquisition, as previously suggested, but

instead a result of other factors such as variability in teaching and learning methods, or motivation to learn. Continued use of the L1 was not measured for in this study, which could also potentially explain the results, as seen in Piske et al.'s (2001) work. Indeed, these results may even be a reflection of the participants' attitudes towards the tasks set before them, enabling other contributors to intraspeaker variation such as interlocutor (the interviewer, an unfamiliar person) or the audience (the researcher hearing the tapes of participants' speech) to cause the changes seen.

6 Conclusion

This study was based on Labov's work on attention paid to speech as a factor of intraspeaker variation applied in an SLA context. This was investigated by addressing two research questions, the first being the way in which formality and attention paid to speech affected the production of the dental fricative, considered 'standard', and the second focusing on the nonstandard replacement sounds in the productions where variation did occur. With regards to the first research question, the use of the sociolinguistic interview in this study to replicate Labov's methods allowed speech samples to be elicited in a range of contexts from least formal, with least attention paid to speech, to most formal, with most attention paid to speech. The auditory and acoustic analysis of standard dental fricatives and replacement sounds provided evidence for a similar trend of intraspeaker variation in L2 English speakers as in L1 English speakers, with the exception of the wordlist condition where there were fewer standard productions than expected. This analysis also proved fruitful in answering the second research question as to what the replacement sounds were in instances where nonstandard productions occurred, showing a consistent pattern of voiced dental fricatives being replaced by voiced alveolar plosives. This is as expected from the three models of speech production and perception cited in the literature review, particularly following Best's (1994) predictions that sounds will be replaced with those with the most similar 'articulatory-gestural' features, as well as evidence from other studies which show L2 speakers of English with different L1s also commonly use this as a replacement sound (e.g., Rahman & Hasan, 2019). It also showed that replacement sounds for standard voiceless dental fricatives were most frequently voiceless labiodental fricatives, however previous studies' results show that replacement nonstandard sounds for this are more varied (Koffi, 2015).

With this in mind, it must be acknowledged that while these results show evidence for attention to speech affecting productions in L2 speakers of English, this study examined a limited amount of tokens. While this is sufficient as a basis of investigation into this area, further work is needed to confirm the validity of these findings. Included in these are other factors which may have affected participants' performances in the sociolinguistic interview tasks, such as how often they still used their L1, for what purposes did they use each language, or indeed the teaching methods through which they learned English, as these may all have affected their varied use of the dental fricative. It must also be acknowledged that using the Labovian, first wave approach to this question provides a basis for further research, and that more is needed in this area using different sociolinguistic approaches (e.g. Eckert, 2012) to explore further how speakers use phonetic details to construct identities in their L2 and in different contexts. The topic of intraspeaker variation is one which is largely under-researched in the area of SLA, and advances in this niche area would provide many important real-world benefits. These include potential changes in the way second languages are taught and used, with an emphasis on L2 users' speech patterns.

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8 Appendices

The following appendices contain the materials used to elicit tokens for analysis in the reading passage (Appendix One), wordlist (Appendix Two), and pairs conditions (Appendix Three). Words in bold are the target words, containing the dental fricatives. Note that that there are no target words for the casual speech condition, as these were naturally occurring words and as such, there were no pre-planned words for analysis.

8.1 Appendix One

Last Thursday, my family all went to the beach for the day by themselves. I wouldn’t normally like this, but since I had about thirty things to do that day, I was pretty thankful I had some peace. Maybe I’ll go next time they’re going, which might be on the 13th.

8.2 Appendix Two

Beige	Three
Theme	Zone
Thin	Thus
Court	Lick
Though	Rain
Fudge	Thud
Heart	They
Third	Sheet
Light	Torch
These	There

8.3 Appendix Three

Thank / Sank	Throne / Zone
Thumb / Tum	Then / Zen
Thing / Sing	Than / Dan
Thick / Tick	Those / Doze
Thorn / Torn	This / Diss

About the Author

Lucy Gill is a 2020 graduate from the University of Leeds with a BA (Hons) degree in English Language and Linguistics. Currently, Lucy works in market research.

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