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Dental fricatives in the speech of Czech users of English at A2 to B2 level

Dentální frikativy v mluvě českých mluvčích anglického jazyka úrovní A2 až B2

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Declaration

I hereby declare that this thesis is entirely my work based on the sources listed in the bibliography section and the advice of my supervisor. No other sources than those listed were used. The research was also conducted entirely by me. I further declare that this thesis was not used in order to obtain another degree.

In Prague, July 2024

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Rudolf Landa

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Abstract

The thesis aims to research how Czech speakers of the English language with language levels spanning from the A2 to the B2 levels pronounce dental fricatives. Dental fricatives are among the sounds not found in the Czech phonemic inventory and thus may prove challenging for Czech speakers to produce. The theoretical part describes the target sounds in detail phonetically, phonologically and in their varieties in connected speech and across both native and non-native accents. The theoretical part then also summarises some of the important research that has already been conducted about the sounds, and the approaches to teaching them to EFL students. The practical part is strictly research based and studies how the speakers pronounce the target sounds in differing language contexts and if they substitute them by other sounds. Furthermore, it scrutinises possible factors influencing the anticipated substitutions such as the sound's position in a word, its voicing, the adjacent sounds, the spelling of the word and speaker background, such as level of English, sex, age and exposure to English in the speakers' lives.

Key Words: dental fricatives, pronunciation, substitution, phonetics

Abstrakt

Práce zkoumá jak čeští mluvčí anglického jazyka s jazykovou úrovní dosahující A2 až B2 vyslovují dentální frikativy. Dentální frikativy v českém fonetickém inventáři neexistují, a proto mohou být pro české mluvčí složité vyslovit. Teoretická část detailně popisuje vybrané zvuky z fonetického a fonologického hlediska, popisuje jejich různé realizace v souvislé řeči a jejich výskyt v rodilých a nerodilých přízvucích anglického jazyka. Teoretická část dále shrnuje důležitý výzkum, který již na tuto tématiku byl proveden, a zároveň popisuje různé postoje k výuce dentálních frikativ pro nerodilé mluvčí anglického jazyka. Praktická část je výzkumně orientovaná, a zkoumá, jak čeští mluvčí různých jazykových úrovní vyslovují dentální frikativy a kterými souhláskami je nejčastěji nahrazují. V případě náhrady práce rovněž zkoumá různé vlivy, které by tuto náhradu mohly ovlivnit, například pozice cílových hlásek ve slově, znělost, sousedící hlásky, psaná podoba, jazyková úroveň angličtiny, pohlaví, věk, a kontakt s anglickým jazykem v každodenních životech mluvčích.

Klíčová slova: Dentální frikativy, výslovnost, náhrada, fonetika

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Introduction

As the dental fricatives do not exist in the Czech language, and their teaching may often be neglected in favour of teaching other skills in the language, they tend to prove troublesome for Czech speakers to produce. The thesis aims to research how speakers from the Czech Republic produce the target sounds, and if they substitute them by other sounds. My personal motivation for researching the dental fricatives is that, before attending university, I had struggled with them greatly and had never been taught how to correctly produce them, so I always substituted them.

The theoretical part aims to describe the sounds in detail from both the phonetic and phonological points of view. Moreover, it describes their written representations, how they behave in connected speech and their capacity to influence or be influenced by adjacent sounds. It also illustrates a wide variety of their representations in various English accents, both by native and by non-native speakers. It summarises important research in the area of Czech pronunciation of dental fricatives that had been conducted before. Finally, it portrays several points of view on the teaching of the sounds for EFL students.

The practical part offers hypotheses based on the previous research and describes how my own research was conducted using the perceptual analysis of recording audio samples of readings of the compiled texts. Most importantly it showcases what the research results are, focusing on recurring patterns in the speakers' production of the target sounds and their substitution by other sounds and factors that may have influenced the outcome. After explaining the research outcomes, the thesis further delves into potential teaching implications, and suggests further research that could be conducted on this topic.

THEORETICAL PART

The theoretical part focuses on setting the foundation of the research, it describes the target sounds, English dental fricatives, in a detailed manner focusing on their phonetics and phonology. It also describes their wide variety across accents and EFL teaching approaches.

1. Introduction to the classification of speech sounds

The most common way of human communication is speech (Ogden, 2009, p. 2), and for this method of communication, humans produce a variety of different speech sounds, otherwise known as phones. These are all the individual sounds that form a certain word, for example the sounds /m/, /e/ and /n/ in the word "men". If these sounds are capable of changing a meaning of a word, they become phonemes, for example in the words "men" and "man" it is easily provable that the /e/ and /æ/ sounds are phonemes, as their respective use changes the meaning of the words (Ogden, 2009, p. 5).

These sounds are produced in a person's vocal tract. In English, all sounds need air from the lungs to be produced, more technically, they are egressive pulmonic, that is to say, that the airstream is created in the lungs and is later exhaled during speech, rather than vice-versa (Cruttenden, 2014, p. 9), apart from certain dialects of English where certain sounds, such as /p/, /t/ and /k/ may be produced in a different way (Cruttenden, 2014, 29).

The airstream is subsequently modified in the vocal folds, located in the larynx in the throat. The vocal folds are two structures on the cartilage that allow the air to pass through a space between them, called the glottis (Ashby & Maidment, 2005, p. 22). The folds can also vibrate, which modifies the airstream to produce voicing. Most phones in English are voiced sounds, including all vowels, but also a majority of consonants. Some consonants are, however, produced without voicing, and thus are labelled as voiceless. Voiced and voiceless consonants are also differing in the energy used to articulate them, where voiceless sounds need more muscular effort and stronger breath to be produced, and are labelled as "fortis", while voiced sounds need less effort and are labelled as "lenis" (Cruttenden, 2014, p. 31). In some cases, the voicing of a voiced consonant may also be lost, both partially and fully, in a phenomenon known as devoicing, for example the /g/ at the end of the word "big". The loss of voicing does not turn the /g/ into its voiceless counterpart /k/, because it still retains its lenis character.

After the modifications in the larynx, the airstream travels further up to either the oral or nasal cavities, where it is modified further by both active and passive articulators, such as the tongue and the roof of the mouth, and is afterwards produced as speech once it leaves the body (Ogden, 2009, p. 10-11).

Speech sounds are divided into two categories based on their function and phonetic features: vowels and consonants. Vowels are always voiced and are sonorants, which means that they are more prominent and have higher acoustic energy. They function as the peaks of syllables and main carriers of sound, and are required in all English words. Phonetically, vowels can be described as sonorant sounds that do not contain any obstruction to the airstream (Cruttenden, 2014, p. 27-28, 34). Different vowels are produced by changing the position of the tongue (from the front of the oral cavity to the back and from its top to bottom). This causes what is referred to as vowel quality, and is the main factor when it comes from differentiating one vowel from another (Ashby & Maidment, 2005, p. 72-74). Vowels may also differ in their quantity (in simpler terms, length), but unlike quality, the quantity of a vowel can change in certain cases without changing the character of the vowel itself, and thus, cannot be accurately used to distinguish them. This becomes even more apparent, when pre-fortis shortening is taken into account. Pre-fortis shortening occurs when vowels precede a consonant of fortis character, and its duration is shortened to help distinguish between minimal pair words which only differ in the voicing of the consonant, so the vowel in "father" /fɑː.ðə/ is noticeably longer than the vowel in "bath" /bɑːθ/ (Cruttenden, 2014, p. 100).

Vowels also include diphthongs and triphthongs (sometimes called glides), which are a sequence of multiple vowels (two in diphthongs and three in triphthongs) that function as one phone, as in /aɪ/ in "wine" (Ashby & Maidment, 2005, p. 9).

Consonants tend to function as the edges of syllables. Due to this difference in function, some sounds like nasals and approximants, which would phonetically be vowels, are classified as consonants due to how they are used in the language (Cruttenden, 2014, p. 53). Consonants also function as the primary carriers of meaning. If all vowels are omitted from a word in its spelling, in a lot of cases it is still intelligible what the original word was, for example, if one was to write "tr-v-l-r", it would be pretty easy to decipher that the original word was "traveller", whereas if only "a-e-e" is written, it is virtually impossible to decipher the meaning of the word (Ashby & Maidment, 2005, p. 80-81). Consonants are typically less sonorous, and differ more in their articulation and voicing.

1.1. The classification of consonants

Individual consonants differ in multiple areas, which helps to identify them. First they may be divided by their manner of articulation, meaning how the sound is produced with the use of articulators. The sounds are first divided into sonorants and obstruents (Ashby & Maidment, 2005, p. 54)

Approximants, the first type of sonorants, are produced in a manner similar to vowels, with no obstruction of the exiting airstream, examples being: /r/, /w/, /l/ (Ogden, 2009, p. 76). The other type of sonorants, nasals, are produced by creating a full obstruction in the oral cavity, and only allowing the air to escape through the nasal cavity instead, examples being: /n/, /m/ (Ogden, 2009, p. 138). Some sonorants may also, just like vowels, function as the peak of a syllable, such as in the words "bottle", where a syllabic /l/ is found, or "rhythm" where this function is taken by a nasal, /m/, instead.

Obstruents all involve a certain degree of obstructing the airstream's path through the vocal tract by using the articulators. The type of this obstruction then further divides them into categories, with three of them existing in most English accents. Plosives are the first type, the obstruction is complete, to the point that no air can escape the tract, and stays trapped behind the articulators responsible for the obstruction, the velum (soft-palate) is also raised in a way that no air can escape through the nasal cavities (Ogden, 2009, p. 96). The air stays in the oral cavity for a while, and then the obstruction is broken by moving the articulators further from one another so that the airflow can exit the cavity. Due to the built-up pressure, the sound is released alongside with burst, called plosion (examples: /t/, /b/, /k/). The next type is fricatives, where an obstruction is created by bringing two articulators in close proximity, but not close enough to fully block the airstream's passage, instead it creates friction between the aforementioned articulators (Roach, 2000, p. 48). The sounds are also considered continuants, as the speaker may create them continuously as long as there is air in their lungs (Pospíšilová, 2011, p. 7). Examples include /s/, /θ/ and /ʒ/. The last type is affricates, which are combinations of a plosive onset ending as a fricative /dʒ/ and /tʃ/.

Consonants are also distinguished by the place of articulation, which focuses on which articulators are used in the sound's production, and where. To exemplify, the sounds /f/ and /v/ are articulated by the lower lip touching the upper teeth, which gives them their distinct sound, and differentiates them for other fricatives like /s/ and /z/ in whose production other articulators are used (Ashby & Maidment, 2005, p. 57).

The last two criteria according to which consonants differ are voicing and force, where some consonants are produced with the vocal folds vibrating and creating voice, while some are not. Voiceless consonants tend to be produced with more muscular effort and stronger breaths, and thus, more force, whereas voiced consonants require less force (Cruttenden, 2014, p. 31).

2. Description of the English dental fricatives

2.1. Phonetic description of the dental fricatives

2.1.1. Articulatory description of the dental fricatives

Like most other fricatives, the sound is created with a partial obstruction in the oral cavity, which does not restrict the air from exiting the body, but it modifies it by creating friction between the two articulators in close proximity, which results in audible turbulence. The velum is raised in their creation, blocking the nasal cavity, so that the airstream can only escape through the mouth. Regarding the place of articulation of the sounds, there are two distinct ways of producing the sound, the typical dental one involves the active articulator, the tongue, making contact with the passive articulator, the backside of the front upper teeth. Some speakers, however, produce them in a so called interdental way, where the tongue protrudes between the front upper teeth and lower teeth (Ogden, 2009, p. 127), this is done intentionally in some accents, or it may be also used in pronunciation teaching of the target sounds (Roach, 2000, p. 51).

The obstruction created is rather small in comparison to some other sounds, and the thus airstream is allowed to escape through a wide channel, which makes the friction weaker, and the sounds, as a result, are quieter (Ogden, 2009, p. 127) and also lower in pitch (Cruttenden, 2014, p. 199) compared to fricatives with stronger friction, also called sibilants, such as /s/ and /z/ (Jekiel, 2012, p. 30).

Compared to one another, the two phones mainly differ in voicing and force, where the /θ/ sound is voiceless, in other words, created without any vocal fold vibration, and the /ð/ sound is voiced. The voiced sound can, however, lose its voicing in initial and final positions. The voiceless sound is also stronger in force, requiring more effort to be produced, and the voiced sound is weaker in force, not requiring as much strength and effort. The voiceless are thus marked as fortis, and the voiced as lenis.

2.1.1.1. Coarticulation

Dental fricatives can retrospectively influence the production of the preceding alveolar plosives in a process called dentalisation, and change their place of articulation to dental as well, and example phrase to illustrate is “that thing”, where the /t/ before “thing” can be produced dentally, or interdentally, for a smoother production (Ashby & Maidment, 2005, p. 124), it is important to note that the sound still remains a plosive, the phonetic symbol of these sounds are [t̪] and [d̪]. The alveolar nasal, /n/ can undergo the same process, when it becomes dentalised in words like “months" or “tenth”, the phonetic transcription of this sound is the following [n̪] (Cruttenden, 2014, p. 308). The voiced alveolar lateral approximant /l/ can also become dentalised in this process, becoming dental in words such as “wealth” [ˈwel̪θ]. The voiced post-alveolar approximant /ɹ/ may turn into the alveolar tap /ɾ/ in clusters following the voiceless dental fricative, with the production of “threat” being [ˈθɾet] (Tench, 2011, p.69).

2.1.2. Acoustic description of the dental fricatives

The fundamental acoustic properties of sound include frequency, duration and amplitude (Cruttenden, 2014, p. 18). The frequency of a sound describes how often the air particles vibrate, and is measured in Hz (Hertz), it also differs a bit from speaker to speaker, where male speakers are likely to have a lower frequency than women do. The amplitude is the sound’s energy, measured in dB (decibels), and the duration then refers to how long a sound is, which is however not used in English for telling specific sounds apart, due to many sounds having variable lengths. If there is a lot of energy in a particular frequency, the band of energy is called a formant (Ashby & Maidment, 2005, p. 22). Formants can be used to distinguish sounds, mainly vowels, from one another (Cruttenden, 2014, p. 20).

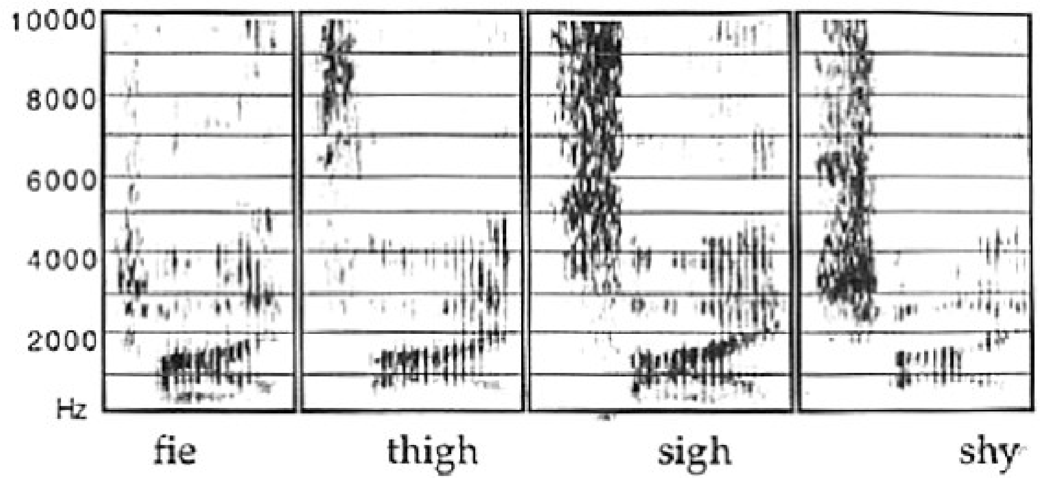

Fig. 1 Spectrograms of voiceless English fricatives in minimal-pair words. (Ladefoged, 2005, p. 57)

The figure above consists of four different spectrograms of four voiceless English fricatives in minimal pair words. Compared to other English consonants fricatives as a whole may get much higher in frequency (Ladefoged, 2005, p. 57). When focusing specifically on the dental fricatives, compared to the voiceless labiodental fricative /f/, the voiceless dental sound reaches a noticeably higher frequency, and its energy is distributed predominantly in these higher frequencies. Both the range of frequencies and the energy are significantly lower than the voiceless sibilant fricatives /s/ and /ʃ/, which span from lower frequencies to higher ones and have a much stronger amplitude over this entire span (Ladefoged, 2005).

A similar pattern exists for the voiced variant, where the main way to determine the voicing is the presence or lack of the fundamental and periodic F0 formant, which originates with the vibration of the vocal folds; its lack therefore means that the sound in question is that of the voiceless variant (Machač & Skarnitzl, 2009, p. 40). The energy of voiceless fricatives is also higher, illustrated by a broad frequency band, called the noise formant (Machač & Skarnitzl, 2009, p. 40). The voiced variants also tend to have a shorter amount of the friction (Cruttenden, 2014, p. 125)

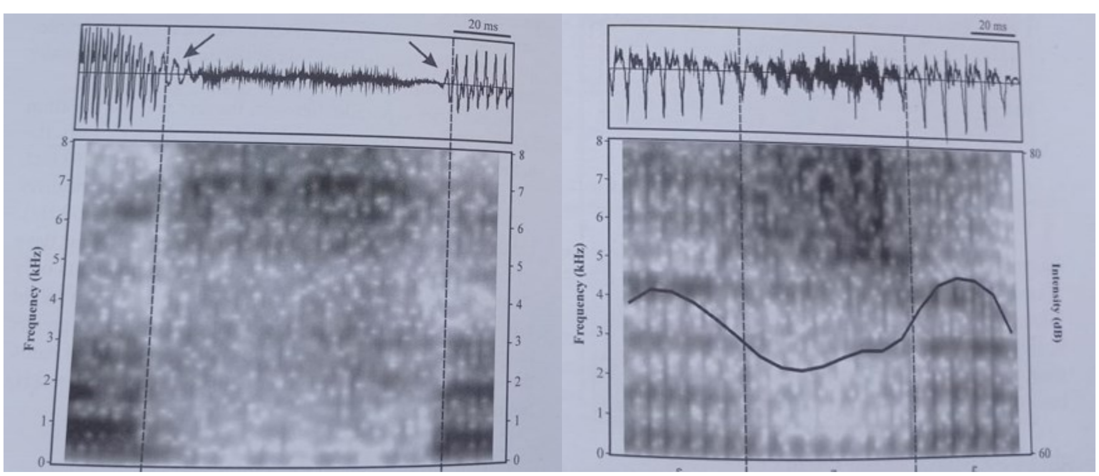

Fig. 2 Comparisons of voicing in spectrograms with a voiceless sound /s/ on the left and a voiced sound /z/ on the right. (Machač & Skarnitzl, 2009, p. 42, 43)

Figure 2 consists of two spectrogram images comparing the sounds /s/ and /z/ between vowels, the first being the voiceless sound, showcasing no F0 formant, whereas in the second graph, the F0 formant in the low frequencies at the bottom of the spectrogram is clearly visible.

When adjacent fricatives are produced after one another, they can be differentiated by the change of the placement of their respective broadband formants (Machač & Skarnitzl, 2009, p. 120), this can be illustrated in plural forms such as “baths” where the dental fricative is produced before an alveolar fricative.

2.1.3. Auditory description of dental fricatives

The auditory features of speech sounds are heavily dependent on the acoustic ones, the main features being loudness and pitch, which are the perceived frequency and amplitude respectively. The primary difference between acoustic and auditory aspects is that the auditory ones are perceived subjectively, and cannot be measured physically. Due to the aforementioned knowledge on the acoustic characteristics of the dental fricatives it can be deduced that they are high in the perceived pitch due to their higher frequency, and so are perceived higher, they are also perceived as louder than the labiodental fricatives /f/ and /v/, but noticeably quieter than the sibilants due to their amplitude /s/, /z/ /ʃ/ and /ʒ/.

2.2. Phonological description of dental fricatives

English dental fricatives function as phonemes, as their presence in a word is capable of changing the meaning, this can be illustrated with the minimal pair example words “thin” and “tin” transcribed as /θ̱ɪn/and /t̠ɪn/ respectively for the voiceless variant; and “then” /ð̱en/ and “den” /d̠en/ for the voiced variant. There are also minimal pairs proving that these sounds are not interchangeable, exemplified by “thigh” /θ̱aɪ/ and “thy” /ð̱aɪ/ which both express a different meaning with the voiceless and voiced variant respectively.

The two consonants also phonologically differ in the frequency of use within the language, the voiced consonant occurs much more often, as it is a part of important grammatical words, such as “they” and all other forms of the word, “with”, “than”, “this” and, most frequently, the definite article. In contrast, the voiceless variant is the second least common consonant in the English language after /ʒ/ (Rosewarne & Basso, 2017, p. 1).

2.2.1. Phonotactics of dental fricatives

The voiced and voiceless variants differ greatly in their possible distribution in words (Cruttenden, 2014, p. 259). They may both occur in the initial positions of words and syllables, but the voiced variant only occurs by itself, and not in clusters. When it comes to initial clusters consisting of two consonants, /θ/ can occur as the first element in combinations with the sounds /r/, /w/ and /j/, exemplified by the “through” /θru:/, “Thwack” /θwæk/ and “Matthew” /mæθju:/, the clusters with /r/ are the most common (Cruttenden, 2014, p. 261). Neither of the sounds exist in maximum onset clusters (CCCV).

When it comes to final clusters, both sounds may occur in coda. The voiced variant occurs only as the first consonant of the final cluster, for instance plural inflectional suffixes, as in "clothes" /kloʊðz/,or with past simple suffix, as in "breathed" /briðd/. The voiceless variant also occurs as the first element when followed by an inflectional suffix, however, unlike the voiced sound, it can also be the second element of VCC clusters, when preceded by one of the following sounds: /p/, /t/, /d/, /m/, /n/, /l/ and /f/, which can all be exemplified by example words: "depth" /depθ/, "eighth" /eɪtθ/, "width" /wɪdθ/, "warmth" /wɔːmθ/, "month" /mʌnθ/, "stealth" /stelθ/ and "fifth" /fɪfθ/. In rhotic accents a cluster with /r/ also exists, such as in "fourth" /fɔːrθ/. Most of these clusters can be extended into VCCC clusters with the addition of the plural s, resulting in words like "depths" /depθs/ or "widths" wɪdθs. The last possible type of cluster is VCCCC, where the voiceless dental fricative may, although rarely, once again occur in the plural forms of words such as "twelfths" /twelfθs/ or "thousandths" /θaʊ.zəndθs/ (Cruttenden, 2014, p. 262-263).

2.3. Grapheme to phoneme correspondence of dental fricatives

Both of the dental fricatives are represented by the grapheme <th> in English, due to this, they are often referred to as "th sounds". (Tench, 2011, p. 39). When the voiced variant occurs at the end of a verb, it is also often represented as <the>, such as in the word "bathe", although some are still only represented as <th> such as "bequeath" (Nosek, 1991, p. 20-21).

Even though the dental fricatives are referred to as the "th sounds" due to their grapheme <th>, the grapheme can sometimes refer to the alveolar stop /t/ rather than the dental fricatives. This is almost exclusive to some words of greek origin such as "thyme" /taɪm/ or in many personal names, such as "Thomas" /tɒməs/ (Nosek, 1991, p.13).

2.4. Dental fricatives in connected speech

When talking quickly, the speech sounds may affect their adjacent sounds, which are subsequently altered in some way, this is known as connected speech, and may occur in multiple ways (Roach, 2001, p. 53-55).

2.4.1. Assimilation

Assimilation refers to the sound changing in some way based on the following or preceding sounds. The first example is the regressive assimilation of place of articulation, where the voiced sound changes to an alveolar fricative if the following word also starts with an alveolar fricative, for example the sentence "I loathe surfing" would be produced as [aɪ ˈləʊz ˈsɜːfɪŋ] (Rosewarne & Basso, 2017, p. 5). A similar process may also happen progressively, where a voiced dental at the beginning of a word, following a word ending in an alveolar fricative, may also become alveolar, an example sentence would be "What's the time?", produced as [ˈwɒts zə ˈtaɪm].

Another example of assimilation is the regressive assimilation of voicing, where a voiced sound may become its voiceless counterpart in grammatical words, this happens in phrases like "with time", where the voiced /ð/ becomes the voiceless /θ/ triggered by the voiceless /t/ in "time"

(Cruttenden, 2014, p. 310). This may also be only partial, where the sound only becomes partially or fully devoiced without completely turning into the fortis counterpart (Rosewarne & Basso, 2017, p. 5).

The final type of assimilation occurring with dental fricatives is the progressive assimilation of manner, where the sounds are transformed into dentalised plosives or nasals. The sounds become plosives when the sound following them is one of the alveolar plosives /t/ and /d/, such as in the imperative sentence “Read this!”, the voiced dental fricative is turned into a voiced dental plosive [ˈri:d d̪ɪz], if the plosive is voiceless, the voicing also changes, to exemplify, the dental fricative in “Rate this” would become a voiceless plosive [ˈreɪt t̪ɪz]. A transformation into a nasal could happen in phrase “In the garden”, becoming [ɪn n̪ə ˈgɑːdən] (Rosewarne & Basso, 2017, p. 6-7). These same positions can however also dentalise the alveolar sound instead, in which case “read this” would be [ˈri:d̪ ðɪz] (Cruttenden, 2014, p. 308).

2.4.2. Elision

Dental fricatives tend to undergo elision when they are in consonant clusters. Usually this happens at the end of words with inflectional suffixes, where the word “depths” would be pronounced as [ˈdeps] after omitting the voiceless dental sound. The voiced variant can be illustrated in the word “clothes”, which may be produced as [ˈkləʊz] It may also happen in other words such as “asthma” [ˈæs.mə]. The voiced variant may also undergo this process at the beginning of weak forms of grammatical words, such as “Bring them” being pronounced as [ˈbrɪŋ‿əm] (Rosewarne & Basso, 2017, p. 8).

2.5. Variations of dental fricatives across accents

While the sounds occur in the standard General British and General American accents, they are not stable in some other accents, and may be changed or omitted. There is a rather wide variety of other potential pronunciations across multiple accents, which will be further exemplified, both in native accents, and in non-native accents.

2.5.1. Variations in native accents

When it comes to the British Isles, one of the most notable examples occur in the London working class dialect called Cockney, the dental fricatives are substituted with labiodentals. So the sentence “Throw it through a window” would be realised like [ˈf̠rəʊ ɪt ˈf̠ruː ə ˈwɪndəʊ] (Cruttenden, 2014, p. 90), this is otherwise known as th-fronting. Th-fronting occurs in all positions for the voiceless variant, and in medial and final position of the voiced variant, where the word “mother” would be pronounced as [ˈmʌv̠ə]. In initial positions, the voiced variant can instead become either a voiced alveolar plosive “the” being [d̠ə] or be omitted entirely, resulting in an [ə] pronunciation (Hughes et al. 2012, p. 75-76).

In working-class London speech, there are several other possible realisations of the voiced dental fricative in initial positions. The loss of friction and subsequent transformation of the dental fricative into an approximant version of the sound. [d], [l] and [ʔ] may also be used, resulting in transcriptions such as [ˈdæt], [ˈlæt] or [ˈʔæt] of the word “that” (Wells, 1982, p. 329).

The West country accent has a notable shift concerning fricatives in the initial positions. In words, where a voiceless fricative occurs initially, it is replaced by its voiced variant, this concerns the dental fricatives in examples such as “thorn” which would be pronounced as [ˈð̠ɔːrn]. In clusters with r it is instead replaced by [d], so the word “threat” would be [ˈd̠ret] (Wells, 1982, p. 343).

In the West Midlands, the area surrounding Birmingham, the dentals are sometimes once again replaced by labiodentals, however, only in lexical words such as “father” or “threat”, and not in function words. Some investigation regarding the Black Country accent, which is another accent in a smaller area of the West Midlands also showed possible deletion of the sounds and also the change of the voiced dental into the alveolar tap [ɾ] (Jekiel, 2012, p. 63), which is a sound produced in a similar manner to a plosive, but much quicker, with the tongue quickly tapping the alveolar ridge, and as a result, there is no build up of air pressure followed by a plosion (Ashby & Maidment, 2007, p. 59).

In most Scottish accents, the sounds are present, they do however undergo changes in certain specific contexts. Some words such as “thence” or “although”, which are traditionally produced with the voiced sound, are produced with the voiceless sound, forming [ˈθ̠ens] and [ɔːlˈθ̠əʊ]. In initial clusters with r, the cluster can be represented with different pronunciations in rural areas, being: [s̪ɹ] and [ɹ̥], resulting in pronunciations like [ˈs̪ɹet] and [ˈɹ̥et]. The voiced sound can become /ɾ/ in initial and intervocalic positions, examples include “the” [ɾ̠ə] and “father” [ˈfɑː.ɾ̠əɹ]. Lastly, the voiceless sound can be replaced by /s/ in the final positions - “bath” [ˈbɑːs̠] (Wells, 1982, p. 410).

In certain areas of Scotland, like the Shetland Islands region, the fricatives undergo a th-stopping process and become the alveolar plosive sound [t] and [d] (Jekiel, 2012, p. 66). Similarly, In Western Ireland the sounds also become plosives, but rather than become alveolar, they retain their dental place of articulation, represented with the symbols [t̪] and [d̪], which do function as phonemes in Irish English, and can distinguish word from their alveolar variant, the words “thin” and “tin” may be used as an example, produced as [t̪ɪn] and [tɪn], as they are not homophones. In the South and East of Ireland, they are completely alveolar. In the rural areas in the North, they are produced as dental fricatives. Finally, in the City of Londonderry, the voiced variant may be completely omitted or produced as a lateral approximant [l], forming a [læt] production of “that” (Jekiel, 2012, p. 65-66).

In some areas of the USA, notably Philadelphia, New York, and some other northern cities, the fricatives may change either do alveolar plosives, or to an affricate consisting of an alveolar plosion followed by a dental fricative, [tθ] and [dð], similar to the words “eight” and “width” in GB (Jekiel, 2012, p. 67). The same pattern is observable outside the US in some of the Newfoundland region’s speakers in Canada (Jekiel, 2012, p. 68). The Newfoundlands region also involves the dental plosives [t̪] and [d̪] in areas of historically Irish settlements (Wells, 1982, p. 500).

African American speakers with an African American Vernacular English accent also substitute the sounds with others, but it is more variable based on phonotactics. The voiceless variants can be substituted by either [t] or [f], but only in non-initial positions, so "thing" would be pronounced as [θɪŋ], but "something" would be [sʌmfɪŋ] or [sʌmtɪŋ]. The voiced variant is replaced in all positions. The [v] substitution only occurs in medial and final positions, such as in "father" or "breathe", whereas the [d] substitution may occur in any position, including initial. (Jekiel, 2012, p. 68).

In the Caribbean countries of Jamaica, Trinidad and Barbados, where English is the official language, the fricatives once again change into alveolar plosives [t] and [d], exemplified by the word [ˈfɑːda], which also showcases the lack of schwa. When clusters with r /θr/ become [tr], they may be modified further into the [tʃ] affricate, so the word "Three" may be pronounced as either [ˈtriː] or [ˈtʃiː] (Cruttenden, 2014, p. 93-94).

In Australia and New Zealand, the sounds are, rarely, but increasingly, substituted by [f] and [v] in all positions, especially by younger speakers in New Zealand (Jekiel, 2012, p. 69).

2.5.2. Variation in non-native accents

Dental fricatives are among the rarest sounds across languages, and as a result, most EFL students will have their first language without them. This may lead many non-natives speakers to substituting the fricatives with other sounds found in their respective languages (Cruttenden, 2014, p. 200). Apart from their difficult production the sounds are also troubling in perception, which makes it even harder for EFL speakers to produce them correctly (Wester, et al, 2007, p. 1). According to Cruttenden, the most common alternative pronunciations are [t] and [d] in most speakers, and [s] and [z] in the speakers of German and French (Cruttenden, 2014, p. 200).

When Wester et. al conducted research on the pronunciation of the dental fricatives by native Dutch speakers in 2007, they predicted that the most likely substitutions will be as follows: alveolar plosives, because of their markedness; alveolar fricatives, because of their phonological similarities; and labiodental fricatives because of their phonetic similarities (Wester, et al, 2007, p. 6). The results of their research showed that [t] and [d] were the most common substitutions, with [s] and [f] following, [s] being more prominent in final positions, while [f] occurred more frequently in the initial positions. The voiced variant was substituted by [z] rarely, and never by [v] (Wester, et al, 2007, p. 7), showing that the results can be quite variable.

When focusing specifically on the subject of this thesis, Czech native speakers, the three main substitutions are, once again, [s], [f] and [t] for the voiceless variant, and [d] or [z] for the voiced variant. Another common mispronunciation is the cluster [d͡z] (Pospíšilová, 2011, p. 12).

Previous research on this topic by R. Skarnitzl and J. Rumlová, which showed that the sounds were commonly substituted by Czech accented speakers. 75% of speakers substituted the voiceless fricative, and the voiced fricative was similarly, only pronounced correctly by a third of the speakers. The most common substitute was [t] for the voiceless variant, and [d] for the voiced variant. The voiced variant was more frequently pronounced correctly in lexical words than in grammatical words, where the [d] substitution was significantly more common (Skarnitzl & Rumlová, 2019).

Similar results occurred in research conducted by J. Sobotík, which showed that the most common substitute for the voiceless variant, was once again, [t] and its aspirated allophone, followed by [f]. The correct production of the voiceless dental fricative was still common. The substitution by [s] was rare, and only occurred in two instances. The voiced variant was in most cases produced as the plosive [d], and, unlike the voiceless variant, the labiodental fricative [v] was absent. The sound was also produced correctly more frequently than the voiceless variant. The voiced variant was also pronounced with more consistent realisations, only having 4 distinct phones compared to the 9 of the voiceless variant. There were several cases, occurring when the target sounds were placed within a word in the medial position, where the respondents of this research failed to identify if the sound should be voiced or voiceless. This phenomenon mostly occurred in words such as "seething" or "clothed", where the sounds should be voiced, but were nonetheless produced as voiceless. In other positions the distinction between the voiced and voiceless consonants was identified correctly, and such mispronunciations did not happen (Sobotík, 2023, p. 25-31).

It is also notable to mention that another research from 2023 showed that some Czech teachers of English also struggle with the pronunciation of the target sounds. According to the research, the voiced variant of the sound was only pronounced as a dental fricative in 10% of all cases, most often having been replaced by a dental plosive [d̪], followed by the alveolar plosives. The voiceless variant proved to be less problematic for teachers, and was pronounced correctly in almost 75% of all cases, when not pronounced as a fricative, it still retained the dental place of articulation, similar to the voiced variant. In a few cases, the substitutions with [t], [f] and [s] occurred (Čtvrtečková, 2023, p. 45-47). The aforementioned research may be used to justify why a lot of Czech speakers struggle with the sounds, although the teachers do, in most cases, retain the dental character, their production of the sound as a plosive may prove troublesome for students from the point of view of perception, and may subsequently affect their own production.

2.5.3. Didactic perspective on dental fricatives

When it comes to teaching dental fricatives to non-native speakers, many linguists argue that the sounds are among the less important sounds. The main argument is that dental fricatives do not have a very high functional load, that is to say, the ability of a phoneme to distinguish different words (Brown, 1988, p.1-2). This was tested in 2005 at the department of linguistics at Simon Fraser University, where perception tests showed that listeners do not struggle with intelligibility from non-native speakers when they substitute the dental fricatives (Derwing, et al, 2006, p. 1).

It is noteworthy to say that the voiced fricatives tend to be quite difficult to produce, due to the fact that the pressure is formed both in the larynx and in the oral cavity, which may lead to either devoicing or the loss of friction (Machač & Skarnitzl, 2009, p. 41)

When posed with the question of teaching the target sounds in a limited amount of time, G. Brown argued that when dental fricatives are substituted, they should be deliberately substituted by labiodental fricatives rather than other sounds, like alveolar fricatives and plosives; due to them being not only similarly lower in functional load, but also due to their acoustic similarities with the dentals (Brown, 1988, p.1).

In her Lingua Franca Core selection of important features of pronunciation which should be taught to ELF speakers, J. Jenkins also argues that /θ/ and /ð/ do not need to be taught to non-natives, as they do not cause problems with intelligibility and can be easily substituted with other sounds. Furthermore, she argues that the sounds are difficult for most non-natives to produce (Jenkins, 2000).

On the opposite end of the spectrum, some linguists, such as Rosewarne suggest that dental fricatives should be included in pronunciation teaching as they are still phonemes, regardless of their lower functional load and lack of issues with intelligibility. Moreover, he argues that Jenkins' theory ignores the fact that many EFL students will know dental fricatives, especially in the case of Spanish native speakers (Rosewarne & Basso, 2017, p. 11). In addition, if one aims to achieve a native sounding GB or GA accent, the sounds can still be argued to be important and play a role in one's fluency. There may also be a stigma associated with not producing the sounds "correctly" and substituting them.

In summary, the opinions on whether dental fricatives should be taught vary, with some people suggesting that they are important for native-like pronunciation and because of their function as phonemes. Other people argue that the sounds' low functional load makes them unimportant in teaching and that their substitution by some other sounds is a valid means of pronunciation.

PRACTICAL PART

3. Main research hypotheses

The first hypothesis draws mainly on the absence of the target sounds in Czech H1: The native speakers of Czech will struggle to pronounce dental fricatives, and will replace them with other sounds, with the research specifically concerning respondents with the language levels between A2 and B2 according to the CEFR standards. According to previous research, examined earlier in chapter 2.5.2., the most likely sounds for substitution will be [t] and [f] for the voiceless sound, and [d] for the voiced sound, although some more variety is to be expected.

The second hypothesis concerns the sound's position in the word H2: some speakers will tend to produce the sounds with a different accuracy based on the sound's position in the word. Some positions will be more difficult than other positions, this hypothesis is based on previously conducted research on Czech pronunciation of dental fricatives (Sobotík, 2023, p. 25-31). Another hypothesis is connected to this, but more focused on the surrounding sounds H3: the surrounding sounds will influence the way the sounds are pronounced, for example, in initial clusters with /r/, such as in the word "thriller" it is more likely that the sound will not be pronounced dentally even by speakers who would produce it correctly in other contexts. A complete elision of the target sounds in final clusters with /s/ and /z/ is also to be expected due to the ease of pronouncing words that way.

Another major hypothesis draws on similarities between Czech and English in some words H4: Cognates which have a <t> in the Czech spelling and a <th> in the English spelling, such as "autor" and "author" will be more oftenly produced with /t/ due to the fact that the speakers would be used to saying said word without the dental sound because of their native tongue. A similar hypothesis concerns itself with the words function H5: function words will be produced correctly less often than lexical words, this hypothesis is based on previous research on the features of the Czech accent in English (Skarnitzl & Rumlová, 2019).

The last hypothesis takes the background of the speakers into account H6: It is more likely that speakers with lower general level of English will struggle with the pronunciation more, on the same note, people who have been in contact with native speakers of English and those who are more exposed to the language in its spoken form, will probably tend to pronounce the pronounce the sounds correctly. Age may also play a slight factor. On the other hand it is likely that the sex of respondents will not influence the pronunciation whatsoever.

4. Methodology

4.1. Text preparation

The research consisted of several phases, the first of which was compiling a text that would be read by the respondents and recorded. The text needed to include a variety of both target sounds in varying contexts, with a total of 35 instances of the voiceless variant and a slightly lower 24 instances of the voiced variant. The definite article "the" was not examined in the research due to its abnormally high frequency; the same reasoning applies to the word "that", which was also not examined. Another word not examined was "with" due to its capability to undergo a regressive assimilation of voicing, and thus possibly including either sound in certain contexts. The voiceless fricatives appeared in initial, medial and final positions; and also in clusters with /r/ and /s/ in initial and medial positions respectively. The voiced variants were also featured in all positions, including clusters with /z/ in the case of final positions. The words chosen were all relatively common words, this was in order to maximise the likelihood that the respondent had already encountered said words in their lives, and would have at least a slight idea as to how they are pronounced.

The read part was divided into two parts (see Appendix 1), first, a short story consisting of four short paragraphs, and then a sample of 18 shorter unrelated sentences. It was written with the expectation that it should take the reader approximately 2 to 3 minutes, so that the respondents are not overwhelmed, and the analysis would be possible to be done in a timely manner.

4.2. Respondents

Once the texts had been written down and printed, respondents were contacted and interviewed (see Appendix 2). The interviews served both to acclimate the respondents into speaking English by asking simple questions about their mood and interests; and to gather information about each of them, namely: age, sex, the approximate level of English, and data about their exposure to English in daily lives and whether they had ever had any notable contact with native speakers of English or visited an English speaking country. It is notable that the speakers told me their English level themselves, and I could not judge their level very well from the short conversations that we had, so the provided levels of English may be slightly inaccurate in some cases where the respondents would either underestimate or overestimate their level.

The majority of the respondents were high school students of a secondary technical school in Prague, in study programmes focusing on either information technology or a grammar school with a higher focus on IT based subjects (20 out of the total 26), but some were also young adults who had already finished high school and were either studying university or working when the research was conducted; this means that the examined age range is of a relatively small interval with the youngest subject being 15 years old and the oldest being 23, with the average age of 17.8 years.

Most of the speakers were also male, as the research only included 6 females. Speakers of the A2 level were also less common than speakers of the higher levels. All of the speakers had at least some level of exposure to English in daily lives, although only some of them had actually had contact with a native speaker of the language.

4.3. Data collection

Before the recordings started, the speakers were assured that the recordings will be anonymised. The interviews were conducted in calm environments to lessen stress. After interviewing the respondents, they were handed the texts, and were allowed to read them silently first, so that the recorded reading would be as fluent and natural as possible. Then they were introduced to two main rules, being that, first: if they do not now how to pronounce a word, they are to pronounce it as they would think it is pronounced, and secondly, that if they make a mistake and want to correct it, they must make a short pause, and then return to the beginning of the given sentence or phrase. Once the respondent confirmed that they understand everything and that they feel ready, the recording was started. The reading was recorded in the WAVE digital audio format, which is encoded in a high bit depth without using compression methods ensuring the highest possible quality (Jeřábek**)**.

Following the reading the respondents could ask questions and give feedback on how they felt, although in the cases of the high school students they could not be told the aim of the research at that point due to the possibility of spreading it to other potential respondents. Several respondents admitted that reading out loud was difficult for them, and that they felt an increase in stress during the reading, this may of course have an effect on their articulation and therefore also the results of the research. Some respondents also said that they did not understand the difference between the words "bath" and "bathe" and similar examples. They also said that there were several words that they had never seen before and thus did not know how to pronounce them. When some of the older respondents were told about the purpose of the research they also admitted that they had never been told that the dental fricatives exist and that they should be read differently than the Czech substitutes.

4.4. Data analysis

The analysis of the recordings was primarily based on perception, where I would play the recordings in order, and note down the pronounced sound in each examined phrase in a structured spreadsheet table. I also opted for a spectrogram analysis in the Praat software in some particular instances where the produced sound was difficult to identify by the means of perception alone to minimise potential mistakes.

Each instance of a dental fricative and its actual pronunciation in the recording was written down in a Google Sheets spreadsheet table, sometimes including additional notes in the cases of mispronunciation. After all the recordings had been analysed, further tables were created to distinguish voiced consonants from voiced, and also to divide the text examples into categories based on where the fricative occurred in a given word. In these tables, the produced sounds were arranged by frequency and chart graphs were generated to illustrate the results. Two instances were removed from the analyses, due to most speakers pronouncing them as different words, and them, as a result, being uninformative, these instances were in the phrases “even through the stress” which most respondents pronounced as the word “though”, and “the moths” which were predominantly pronounced as “months”. Afterwards further tables and charts were made according to the collected data about respondents, and the occurring patterns were further analysed.

5. Research results

The results of the analyses showed that, as had been expected, the sounds were often substituted with a wide variety of other phones, with the variety changing noticeably in different contexts and positions. Overall, the most common productions were the alveolar plosives in both the voiced and voiceless categories. The voiced variant was substituted more often than the voiceless variant.

5.1. Production of the voiceless dental fricatives

As shown in the chart in figure 3: when it comes to the voiceless variety, the sound was most often pronounced as the voiceless alveolar plosive [t] with almost 40% of the instances in all the recordings combined. The voiceless dental fricative was also often pronounced correctly with over 23% of instances, and the labiodental fricative [f] was also very common with roughly 18.5%. The voiceless alveolar fricative [s] is present in much fewer cases than was originally anticipated. Several sounds, such as [p], [x] or [ɾ] were only observed once in all the recordings. The production also differed noticeably in different positions.

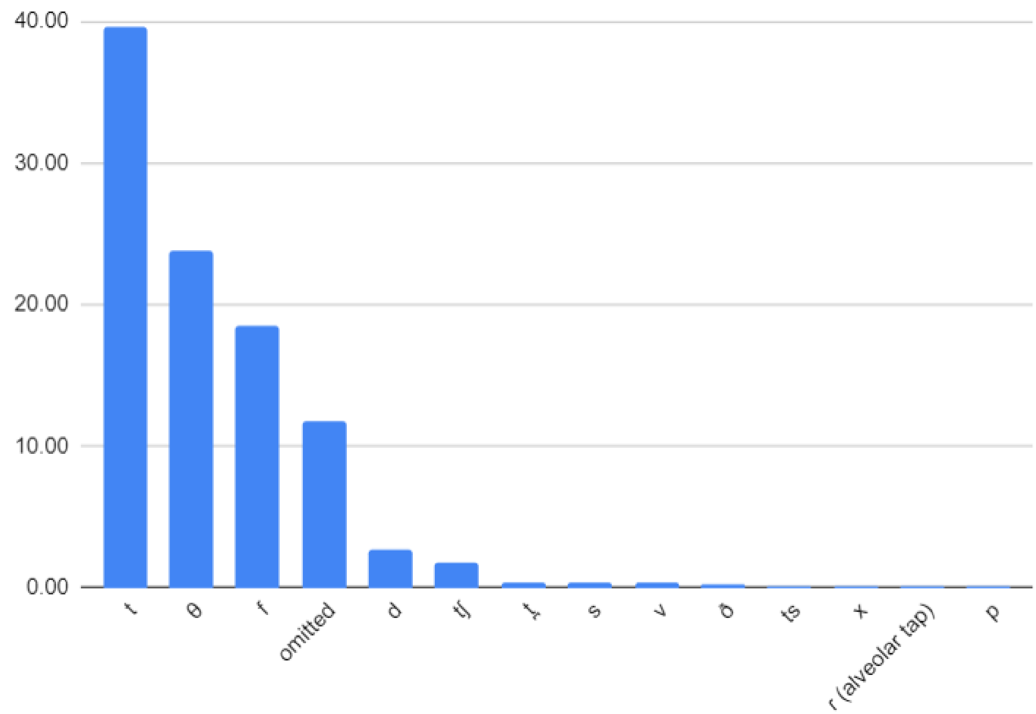

Fig. 3 Overall frequency of /θ/ realisation in Czech English (the y axis shows percentages of pronunciation).

Looking at the realisation of /θ/ in the initial position with a following vowel (see Figure 4) The frequency of the most common pronunciations is approximately the same as the overall production across all positions. The text included 7 different instances of dental fricatives being in initial positions without being a part of a cluster. Interestingly enough, four instances were pronounced as the voiced alveolar plosive [d] rather than being voiceless, three of these four cases occurring in the same sentence: “He **th**ought that there was nothing that could stop him”. With the last occurrence being found in the same word placed in a different sentence. This phenomenon may be explained by the similarity of this word and the word “though” which is pronounced with a voiced sound at the beginning. The dentalised voiceless plosive [t̪] was observed two times, both in the word “thing(s)”, although by different speakers. This word was also produced with [s] one time and with a voiceless alveolar affricate [ts] with the same rate of occurrence.

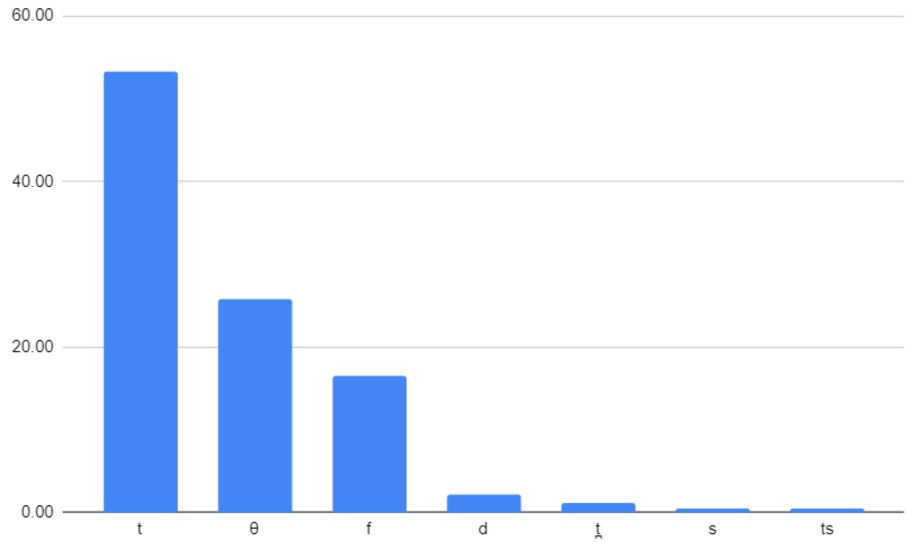

Fig. 4 Frequency of /θ/ realisation in initial positions without clusters in Czech English (the y axis shows percentages of pronunciation).

When it comes to initial clusters with <r>, which were exemplified in the text in 6 phrases, the tendency of mainly using [t] followed by [θ] and [f] is the same. The main differentiation comes with an increased production of the voiceless palato-alveolar affricate [tʃ] in 7% of the cases, with this sound being either absent or very rare in other positions. The speakers who did this also usually did it relatively consistently in at least 50% of the phrases. [s] was also produced more frequently in these clusters than elsewhere, with two distinct cases with two different speakers in two different words.

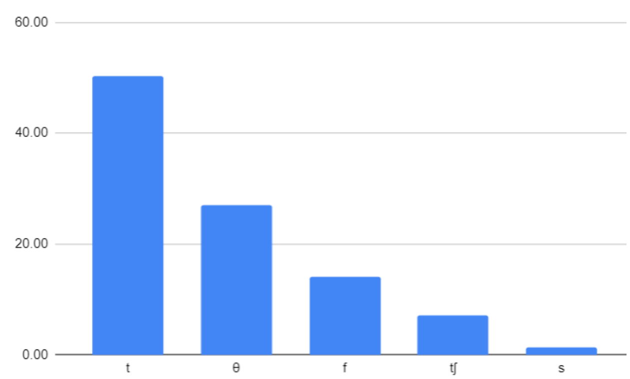

Fig. 5 Frequency of /θ/ realisation in initial positions in clusters with <r> in Czech English (the y axis shows percentages of pronunciation).

Medial positions, included in 7 examples in the texts, show the highest number in variations of used substitutions, although most of these are rare, and only occur in a single or a couple instances. Many of these sounds are surprising because of their unlikeness to the target sounds. Once again, voiced sounds were produced, including: [d] which had previously been pronounced in initial positions, [ð], and the voiced alveolar tap [ɾ], which will be more closely examined in the section on the voiced dental fricatives and their substitutions as it occurs much more commonly in those cases, but it is notable to mention that it was used in the word "author" before the rhotic sound at the end. Notably, the voiceless velar fricative [x] occurs once, this is a sound not existent in general British and general American accents, although some other accents, such as general Scottish, do have them in their inventory (Wells, 1982, p. 408); the Czech language also uses this sound. The sound is, however, correspondent to the grapheme <ch> in both Scottish (Wells, 1982, p. 408) and Czech (Pavel, 2012, p. 11), and as such, its production is thus most easily attributed to an error, especially as it was produced by a speaker who has otherwise pronounced most of the sounds as either dental fricatives or alveolar plosives.

An interesting pattern can be observed when looking at words derived from the word "thing", such as "something", "nothing" and "everything" when compared to the word "thing" prior to further derivation. The word "thing", where the dental fricative occurs in the initial position, was most often pronounced as [t] similarly to most of the words in the research. However, words derived from "thing", where the dental fricative is in the medial position, were more often pronounced with [f]. There was also one case, where the word "something" was pronounced with the voiceless bilabial plosive [p]. This happened with a speaker whose production in these words derived from "thing" was otherwise that of the labiodental fricative.

Another observable tendency happens in cognate words that are similar in English and Czech, but have a <th> grapheme in English and a <t> grapheme in Czech, these words include examples like "Method" and "metoda" or "athlete" and "atlet". In these words the tendency to pronounce the [t] was much higher than in the other examined words, being more than three times as frequent as [θ], the second most frequent sound in these words. This can be attributed to the respondents' familiarity with the words in their native tongue, and their subsequent tendency to pronounce it in a similar way.

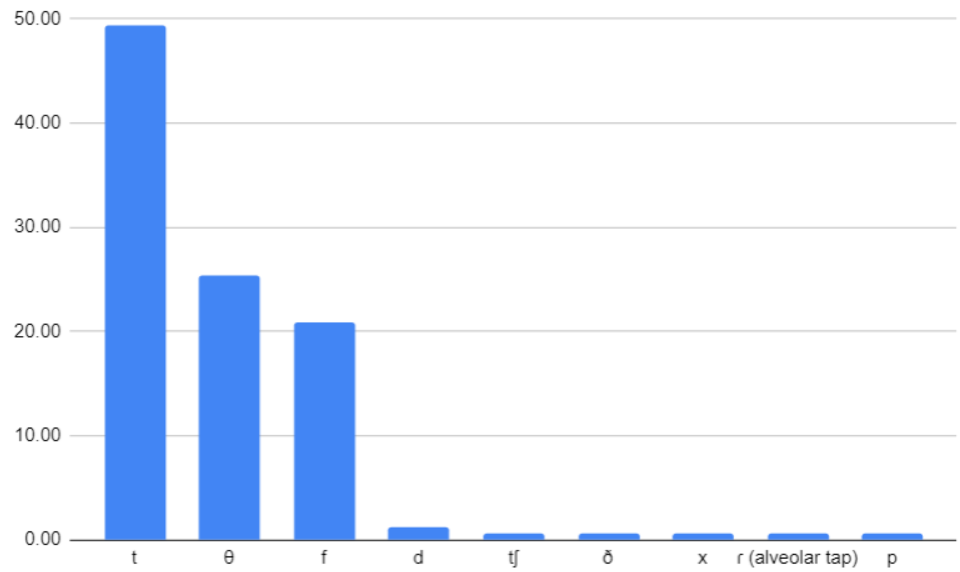

Fig. 6 Frequency of /θ/ realisation in medial positions in Czech English (the y axis shows percentages of pronunciation).

Final positions are once again divided into clusters and no clusters. When no cluster was present, the voiceless dental fricative was the most often pronounced sound, closely followed by [f]. This is notably different to prior examples where the predominant production was that of [t]. Both the voiceless dental fricative and the labiodental fricatives occurred in a much higher frequency in these words than in other positions with both the sounds having over 30% occurrence rate. The texts included 7 distinct examples of dental fricatives in this position.

Similarly to medial positions, final positions without a cluster were rather varied and included several sounds that have only been produced in as few cases as one. Less expected examples do, again, include voiced sounds such as the dental fricative, the alveolar plosive and the labiodental fricative [v], these voiced sounds were more commonly used when the following word started with a vowel such as in the cases of "took his breath away" and "both of his parents". another unexpected sound was the voiceless glottal fricative [h] which was also produced in the phrase "both of his parents", the reason for this production is rather unclear, it could have been a slip in pronunciation or also linked to the <h> in spelling, which is however unlikely, due to this production not occurring in other words read by the same speaker. In two cases, the sound was even omitted altogether, both happening at the end of clauses. [tʃ] was present again with three cases all in the word "truth". Dentalised plosives occurred in both the voiced and the voiceless variety with one case of each of them appearing.

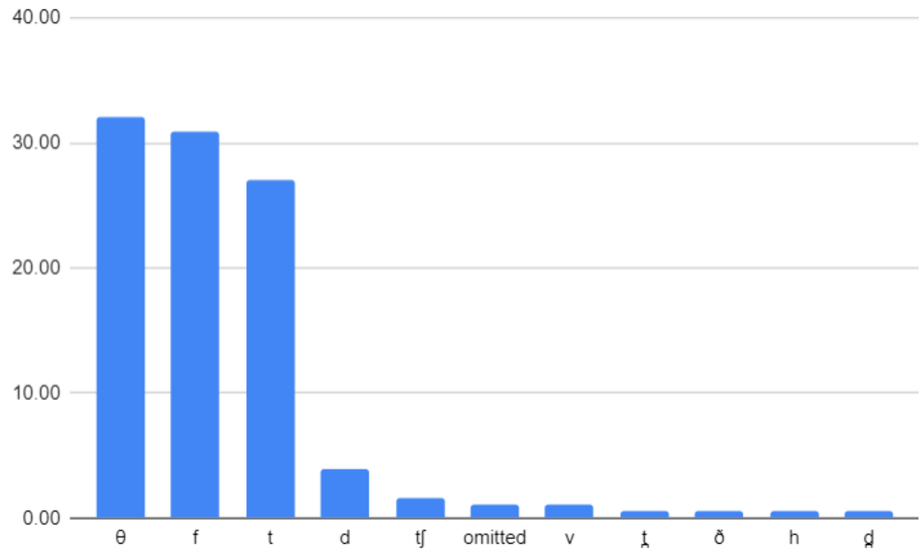

Fig. 7 Frequency of /θ/ realisation in final positions without a cluster in Czech English (the y axis shows percentages of pronunciation).

The last position of voiceless dental fricatives shown in the texts were those in final positions with <s>. The overwhelming tendency in such cases was to omit the sound in the process of elision and only pronounce the following <s> sound which happened in over 60% of all pronunciations. Two speakers omitted the sound in all of the cases, whereas others only omitted it in some words, but left it in other words. All the speakers showed the usage of elision at least twice in the given examples. Several cases instead omitted the s sound, this was less common but still happened rather often, especially in the case of two particular speakers who did so rather consistently. There was also a high amount of voiced alveolar plosives /d/ with over 6%, where the speakers also pronounced the following sound as the voiced alveolar fricative /z/ rather than the voiceless /s/. One such case involved [v] instead. Apart from the elision the general tendency of [t] being the most commonly pronounced sound followed by the voiceless dental fricative remained the same as in most other cases with over 30% of all the non-omitted cases.

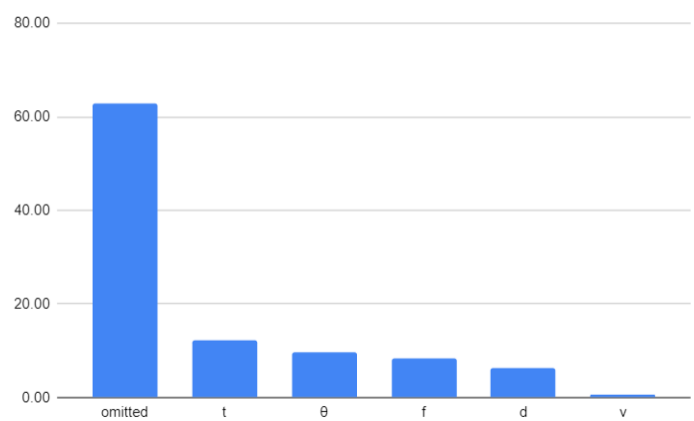

Fig. 8 Frequency of /θ/ realisation in final positions in clusters with <s> in Czech English (the y axis shows percentages of pronunciation).

5.2. Production of the voiced dental fricatives

The voiced sound /ð/ occurred less in the text with 24 instances compared to the voiceless variant's 33 occurrences. The patterns were also significantly different from the voiceless counterpart. The overall number of variations was slightly lower, with 12 distinct speech sounds compared to the voiceless variants' 14. In one case a speaker's production of a word was also mispronounced to the point of not being analysable.

Figure 9 shows all the sounds that were produced in the place of /ð/. Similarly to the voiceless variant, the most common production was that of the alveolar plosive, although voiced in this case, the main difference is that the aforementioned sound was produced in almost 50% of all the cases, which was over four times as often as the second most commonly produced sound, the voiceless variant of the alveolar plosive with 10.75%. The voiced dental fricative was the third most common realisation with only 10.6% of cases in comparison. This is notably different from the voiceless variant, where the three most frequent sounds were much closer in frequency to one another. It is also notable to say that lexical words, such as "father" or "clothes" were pronounced correctly more frequently than function words, where the substitutions were much more common.

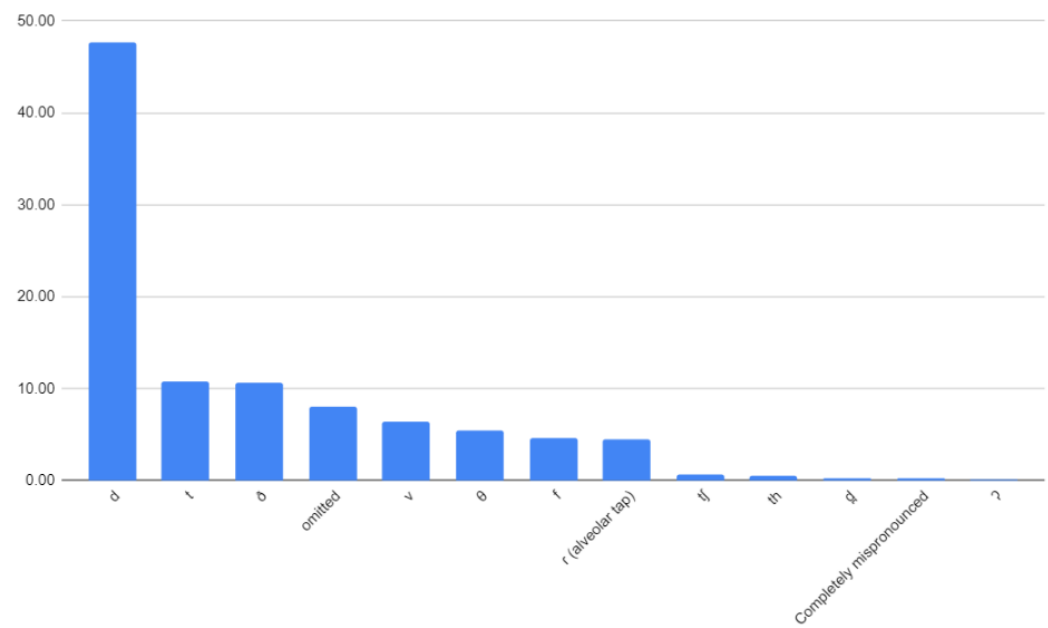

Fig. 9 Overall frequency of /ð/ realisation Czech English (the y axis shows percentages of pronunciation).

In initial positions the dental fricative was only pronounced as the dental fricative 4 times (being only 3%). The overwhelming majority was the pronunciation of the voiced alveolar plosive /d/ with 96.15% cases. There was virtually no consistency in occurrence of the voiced dental fricative, as it occurred across different speakers in different words in a rather random fashion. One pronunciation was that of a dentalised plosive in the clause "**th**ere was nothing that could stop him". The texts included 5 examples where the target sounds occurred in the initial positions, not counting the definite article and the word "that" which were not analysed for reasons described in the methodology part.

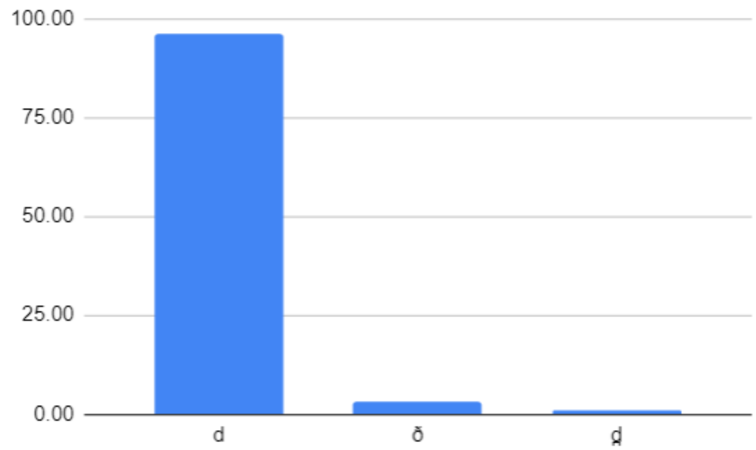

Fig. 10 Frequency of /ð/ realisation in initial positions in Czech English (the y axis shows percentages of pronunciation).

Medial positions, which were exemplified in the texts 8 times, were much more varied in their production compared to the initial positions, with 7 different speech sounds having been used and 1 case of omission. The most common once again being [d] with over 60%. Interestingly, the alveolar tap [ɾ] was almost as common as the voiced dental fricative. Further perceptual analysis of these patterns was conducted and showed that this realisation happened almost exclusively in rhotic speakers in words that end in <er> such as “mother”, “father” or “together” similarly to a previously mentioned case of a similar case in the voiceless section; and would be transcribed as [ˈmʌɾ.ər] in the former case. These rhotic speakers also mostly used the Czech pronunciation of the <r> sound, being the voiced alveolar trill, rather than the English voiced alveolar approximant, which may have influenced this type of production. In the same position, also preceding <er>, one respondent also omitted the sound altogether in the words “together” and “other”, which would then be transcribed as [təˈgerə] and [ˈʌrə]. Another speaker used the glottal stop, once again before <er> in the word “father”, transcribed as [ˈfɑː.ʔər]. From these examples, it can be deduced that the <er> following a dental fricative influences the production of the dental fricative and increases the possibility of it being replaced in rhotic speakers, mostly by the alveolar tap.

The word “rhythm” was correctly produced as dental by over 61% of the speakers, which makes it the word most commonly produced with a dental fricative in the entire list, although it is also important to say that 5 of these cases were the voiceless variant of the dental fricative rather than the correct voiced one. The reason for this tendency is not entirely clear, but may possibly be attributed to the fact that the Czech counterpart of the word “rytmus” is produced with a voiceless consonant. The word “rhythm” was also pronounced once with the sequence of two consonants, /t/ and /h/, forming [th], as if the grapheme was read as two individual sounds. The aforementioned word “rhythm” and another word, “although”, were also oftentimes pronounced as [t] rather than the otherwise common voiced variant [d], in the case of “rhythm” it was even more common than the voiced sound with 75% cases of alveolar plosive realisations in this word.

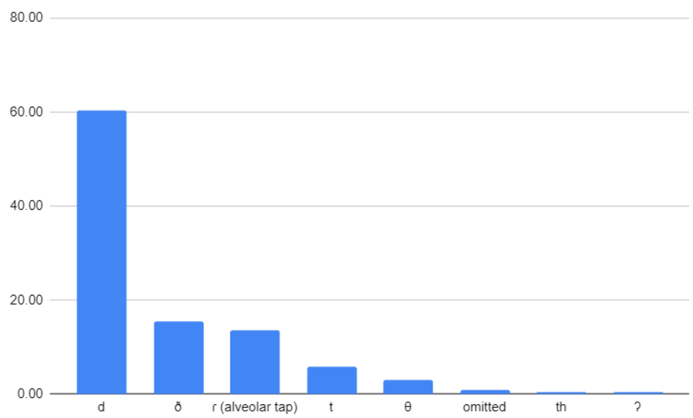

Fig. 11 Frequency of /ð/ realisation in medial positions in Czech English (the y axis shows percentages of pronunciation).

The final positions without a cluster were even more varied than medial positions, with 9 distinct realisations and one case of a word being completely mispronounced. As opposed to most other positions, where the most common realisation was that of /d/, in final positions, [v] was the most common with over 20% of all cases. The word "breathe", for example, was most commonly pronounced as [ˈbriːv].

There was also very little distinction of voicing, as the voiceless variants were almost as common as the voiced variants, the difference in frequency between [ð] and [θ], for example, is less than 1%. This can be attributed to the fact that all the words examined were verbs derived from nouns, which are in their noun form pronounced with a voiceless sound. Many speakers made no distinction between these two realisations in pronunciation and words like "bathe" were produced as "bath" - [ˈbɑːθ] rather than [ˈbeɪð]. This is more telling about the speakers' lack of knowledge on the overall difference of pronunciation between the verb and noun forms of these words rather than the inability to distinguish voicing in general.

Varied productions occurred in the word "bathe" in the sentence "they wanted to bathe for hours", where one respondent produced a dentalised plosive rather than the more typically used alveolar variant, and two respondents used the affricate [tʃ]. These speakers did however keep other pronunciations in the derived word "subathe" in other sentences, where the word occurred as the last word in both of the given sentences.

There was one case of omission in the clause "he struggled to breathe". A single production of [s] occurred in the sentence "I had to clothe my old grandma". Interestingly, there was no case of the voiced alveolar fricative [z]. It is also notable to repeat that the word "with" was not analysed in this category due to difficulties occurring by the word possibly undergoing the regressive assimilation of voice.

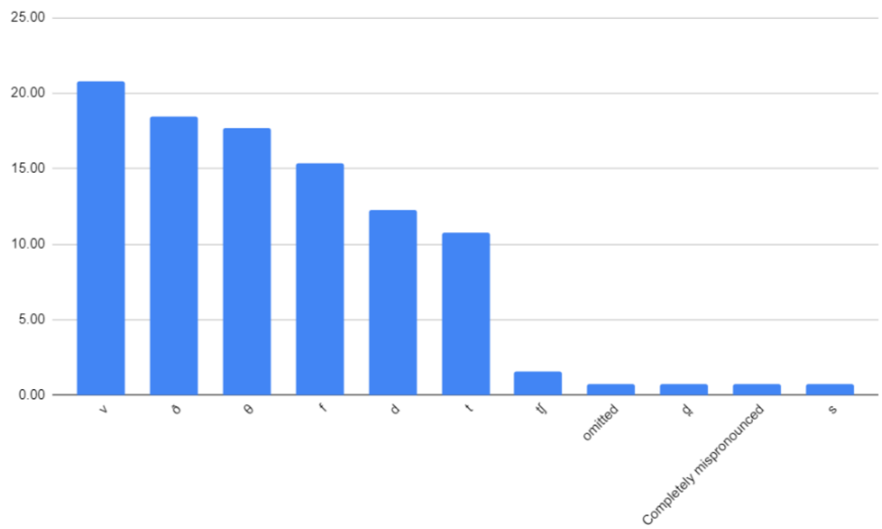

Fig. 12 Frequency of /ð/ realisation in final positions without clusters in Czech English (the y axis shows percentages of pronunciation).

The last category examined was the final positions in a cluster with <s> in inflectional endings. There were 6 examples of this position in the text. The most common production was, just like with the voiceless variant, the omission of the sound due to elision, happening in roughly 30% of all productions. The elision was notably irregular with most speakers only omitting the sounds in certain words, but producing a speech sound in others, although there was one respondent who omitted the sounds in every word with this position of the dental fricative.

The most common speech sound was interestingly the voiceless alveolar plosive [t] which, alongside the following alveolar fricative [s], which most speakers who produced [t] also pronounced without voicing, created the voiceless alveolar affricate [ts]. Words like "clothes" were as such often produced as [ˈkləʊts] rather than [ˈkləʊðz] or [ˈkləʊz].

The actual production of the dental fricatives was rare, with 5 cases of [θ] and 6 cases of [ð], making up about 7%. This led to this position being one of the least frequently pronounced dentally, alongside the initial position, although this may also be caused by speakers who may have otherwise produced the sounds dentally omitting them. There were two cases of each of the affricate [tʃ] and the cluster of [th] in this position. The former occurred both times in the sentence "David bathes three times a week", where the word was produced as [beɪˈtʃiːz]. The latter was produced by the same speaker, both cases in the verb "loathes", produced as [ˈləʊths]. Similarly to final positions without a cluster, there was very little distinction between voicing, and the voiced and voiceless variants were both present in similar frequencies.

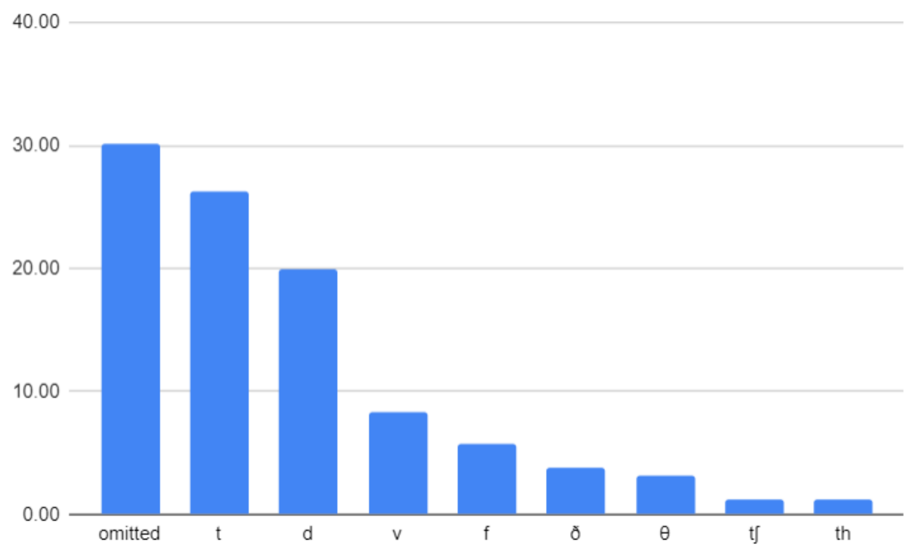

Fig. 13 Frequency of /ð/ realisation in final positions in clusters with <s> in Czech English (the y axis shows percentages of pronunciation).

5.3. The influence of speakers' level of English, sex, age, contact with English and exposure to English on the production

In this section, the data about speakers was taken into account and used to identify possible patterns. All of this data was used to create additional tables to calculate the rate of occurrence. The level of English being first. The speakers with the A2 level very rarely produced the sounds correctly, with only a couple cases of accurate production per speaker. Their common substitutions were [t] and [f] for the voiceless variant and [d] for the voiced variant. The substitutions of the voiceless variant occurred seemingly at random, with many speakers switching between [t] and [f] in the example words. This randomness happened even if the words had the dental fricative in the same position, for example one word with the initial position would be pronounced with a [f] and the next one with a [t]. The previously mentioned switching also occurred if there was the same word several times in the text, in one sentence the speakers would pronounce "thought" as [ˈtɔːt] and in another as [ˈfɔːt]. The randomness was more common in final positions. The tendency to pronounce <th> in clusters with <r> as [tʃ] was also most prevalent in this group of speakers.

Speakers of the B1 level displayed similar behaviour of switching between several sounds but seemed to be slightly more consistent in their pronunciation. Their pronunciation was also the most varied, but this is more easily attributed to the fact that they were also by far the most numerous group of respondents. Elision in final clusters with <s> was also more common, although not by much. Surprisingly, the respondent with the most correct pronunciation of all belongs to this category, rather than the B2 level.

Lastly, B2 level speakers, which was the highest level tested in the analysis, were examined. The inconsistency of producing different sounds in the same positions are still notable, but they manifest in a much smaller extent compared to the previous two groups. The words which were repeated within the texts were also pronounced with the consistent sound more often. This group of speakers involved the most respondents who had produced [ɾ] in place of the intervocalic voiced dental fricative. They were also the only group which produced dentalised plosives. When looking at this group overall, they were the greatest at pronouncing the dental fricatives correctly, with several speakers pronouncing them frequently.

The possible influence of age on pronunciation was also examined. Age had no observable effect on the correctness of production. The older speakers, above the age of 20 did, however, show increased consistency in the production of certain sounds. That means that when a speaker in this group produced a [t] in a word at an initial voiceless position, they were more likely to do so again in the other words with said positions. This is especially noticeable in the cases of elision in final clusters with s where the speakers would either omit the sounds in all or most of the instances, or, they would not omit any of the sounds in the clusters. It is notable to say that out of the 26 speakers, only 5 belonged in this age category; and 4 of them were also women; both of these factors could have had an impact on the results.

Regarding sex, half of the women-respondents examined also showed a very high success rate of pronouncing the dental fricatives, but all of these were also of the B2 level, so it is debatable as to how much of an effect sex may have had, still even women with the B1 level seemed to be more consistent than the male ones, similarly to how the older respondents were more consistent than the teenage ones. The overall influence of sex is unfortunately uninformative due to a high disparity between sexes as only 6 of the 26 respondents were women, this is mainly due to the fact that most of the speakers came from a technically focused high school, where the overall number of ladies is notably smaller than that of males.

Another important factor was the speakers' exposure to English in their daily lives outside of school. All of the speakers surround themselves with English at least to a certain passive extent, most speakers watch content on the internet such as videos, movies or TV shows in English, or they play videogames and read books in English. Some of them also use English actively, sometimes in online multiplayer videogame chats and voicechats, sometimes at work, when they need to interact with foreign customers. Based on the information provided, the speakers were divided into groups based on how much English they encounter in day to day life, the groups being labelled as: low, mid, and high.

The speakers with higher rates of using English were once again more consistent in their pronunciation, and overall were more frequently using the correct dental fricative articulation. The speakers who actively speak English were especially more consistent compared to speakers who mainly interact with the language passively. There were, nonetheless, several speakers who produced the dental fricatives successfully at a high rate despite the fact that their exposure to English was low.

Related to the exposure to English are also the interactions with native speakers of English and the visits to English speaking countries. This was again measured in the groups of low, mid and high based on how long the contacts with a native speaker/visits to the native countries were. With another group added for the respondents who have neither had any contact with a native speaker nor have they visited an English speaking country.

This had similar effects to the exposure to English, so the speakers who were labelled "high" in this category were again a bit more consistent and likely to produce the target sounds as dental fricatives. However, it was only prominent to a lesser extent than the previous category, and only improved the pronunciation slightly in most cases. The speaker with the highest number of correct target sounds pronunciations allegedly never had any contact with a native speaker and has not been to an English speaking country either. It is also difficult to mark down how much both of the last categories influenced the speakers' production, as there is no comparison with how they would produce the sounds if they had not surrounded themselves with English in their daily lives.

5.4. Other findings not related to dental fricatives

Apart from the analysis of dental fricatives, the analyses also showed several recurring patterns in the production of other sounds. As explained earlier, there was a lack of distinction between the noun and verb forms of words such as "bath" and bathe". Rhoticity was overall very high, with rhotic speakers producing both the lateral approximant variants and the alveolar trill variants of the rhotic sounds. The vowel /æ/ was oftentimes replaced by both [a] and [e] in some words. Similarly, many words were read according to the Czech grapheme realisations, with words like "months" being pronounced as [ˈmonθs] rather than /mʌnθs/. The verb "live" in the sentence "The author probably loathes letting his characters live." was in most cases pronounced as the adjective form [ˈlaɪv] rather than the correct verb form /lɪv/. Some words were very commonly mispronounced, the most notable examples being "moths" and "through" as "month" and "though" respectively, another commonly mispronounced word was "mathematician" where there was a significant lack of vowel reduction and the voiceless palato-alveolar fricative was often replaced by the voiceless velar plosive [k] or the voiceless velar fricative [x]. The lack of vowel reduction is also observable in other words, as the Czech respondents produced many sounds where a schwa or a reduced form should have been with full vowel quality. The respondents also oftentimes placed the stress on beginnings of words, rather than following the English stress pattern.

6. Conclusion

The main objective of the thesis was to illustrate how Czech speakers of English may produce the dental fricatives, sounds nonexistent in the Czech language, which also generally prove troublesome for most EFL speakers of the language, and also to find recurring patterns in the pronunciation across multiple speakers and attribute them to factors such as the sounds position in the word, the similarity to some Czech words and the background information about the speakers.

The theoretical part focused on describing the sounds from both the phonetic and phonological point of view. It also focused on how the sounds tend to be pronounced in a variety of accents, both native and non-native. It furthermore reiterated some previous research on how Czech people produce the sounds. And it also delved into common approaches to the teaching of dental fricatives and its importance.

The practical part consisted of creating texts to be read which included a wide variety of dental fricatives in various positions, finding the fitting speakers and then analysing the results by the means of perception from several points of view, and finding patterns in the results.

The results show that the sounds tend to be substituted by a large number of other sounds, and that the voiced dental fricative was overall substituted more often than the voiceless variant, and that the voiceless variant had more variety in substitute sounds. It showed that the sounds' position in words greatly affected the resulting articulation. It also showed that grammatical words were substituted more commonly than lexical words and that cognates which are similar in both languages were substituted more often by the sound occurring in the Czech version of the word. Factors such as age, sex, language level and exposure to English affected both the likelihood of correct production and the consistency of substitution. Language level and exposure to English might have played a vital role in the sounds' articulation in most cases. Age and sex proved to be less impactful, but consistent patterns occurred nonetheless.

Other common pronunciation tendencies were also examined shortly, and most notably showed the lack of vowel reduction and inaccurate stress placement. Vowels were also commonly produced with the wrong quality, potentially also impacting intelligibility.

When it comes to how the results align with the hypotheses, most hypotheses were proven right. As H1 anticipated, Czech speakers struggled with the production of the sounds and replaced them with other sounds, most notably [t], [f] and [d]; other sounds occurred too, with varied frequency. H2, the hypothesis that the sound's position will matter was also correct, as different positions showed different patterns, sometimes drastically so. The adjacent sounds also show a tendency to show a change of production, as was expected in H3, this notably happens in clusters with <r> and <s>, where the variety is different, involving sounds rarely found elsewhere, and, in the cases of final cluster with <s>, leads to omission frequently. Another hypothesis (H4) argued that words that have a similar spelling involving <t> and the production of /t/ in Czech, such as "autor" will be more likely produced with [t] in their English form "author"; this tendency was proved to be correct as well. Concerning the contrast in production between function and lexical words was H5, which anticipated that lexical words will be pronounced correctly more frequently than grammatical words, this was only proven somewhat, as there were not enough examples in the texts to have an exact answer and words such as "the" and "with" were omitted from the analysis due to difficulty. Nevertheless, the words given did point towards this tendency also being true. The final hypothesis (H6) argued about the influence of speaker data about the results. Firstly it argued that language level and exposure to English will play a vital role, and it was confirmed that they might have had some influence, however, it was more about consistency rather than accuracy, as speakers with higher levels and exposure to English did not necessarily produce the target sounds correctly, rather their production was more stable in the substitutions they have produced instead. Age showed a similar result, I also argued that sex will have no influence at all, but this was wrong, as female speakers were once more consistent in production than males, nevertheless.

The results also mostly align with previous research examined in the theoretical part, which suggested both the substitutions and differences between positions. One phenomena that does not align is that [s] and [z] were very uncommon substitutes, although some sources expected them to be more frequent.

Regarding possible teaching implications, in the examined context it seems that dental fricatives are not taught to students enough for them to consistently produce them correctly. On the other hand, it can be argued that dental fricatives are not as important as other phonetic and phonological features of the language due to the sounds' lower functional load and them barely impacting intelligibility in most scenarios. Nevertheless, if a native like accent, the most common of which being GA and GB, is the goal, the target sounds should be taught anyway.

6.1. Further research suggestions and limitations

It is important to mention that there are areas the research did not concern or that some areas were not possible to be examined enough. Although the sounds appeared in a variety of positions in the analysed words, there were some clusters that were absent, notably the voiceless variants' clusters with /w/ and /j/, which could potentially lead to other results. The same goes for the final clusters, where the only ones examined in this thesis were either preceding /s/ or /z/ in inflection, such as in the words "clothes" or "months"; or preceded by /n/ in months. Other preceding sounds such as /p/ in the word "depth", /t/ in the word "eighth" could also differ in production compared to the ones examined in this research. The same goes in cases where the target sound would precede the sound /d/ in the past tense of verbs, such as "clothed" or "breathed".

The influence of sex could be researched further, as the respondents in this research were predominantly males with only a few females, and as such no exact output could have been made clear. The same goes for the impact of age, as the subjects of the research only spanned an interval from 16 years of age to 23 years of age. Older respondents may show a differentiation from the patterns found in the conducted research.

There may have also been slight errors, as the analysis was that of perception of articulation. A more thorough acoustic analysis may show more accurate results. Testing the respondents perception of the sounds and its common substitute in the same words in certain contexts may also show interesting data.

Lastly, more research can be done focusing on how to teach the production of the target sounds accurately, and on how the dental fricatives are currently being taught at schools. Several respondents also did not know the differences in voicing and overall pronunciation between the verb and noun forms of words such as “breathe” and “breath”, so more research could be done on how these differences are illustrated in teaching.

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Appendices

Appendix 1 - The texts compiled for the research

In this part of the appendices, the texts that were read in the recording sessions are placed. The words containing the examined cases of the dental fricatives are written in bold. The two words which were erased from the analyses following their overwhelmingly frequent mispronunciations are also underlined.

Short story

The **athlete** was exhausted, the **things** like lack of sleep combined and the intense training truly felt like **death**. He pushed **through**, because he knew that his **father's methods** would not fail him. **Although** he was tired, he was happy, he trained for **months**. He **thought** that **there** was **nothing** that could stop him. He arrived home to see that his **mother** had bought some new **clothes** for the upcoming match. (16)

He took a **bath** to relax for a while, and when he was done, he ate his dinner, a chicken **thigh** served with **three** dumplings, **then** he went to sleep, a tough day awaited him tomorrow. (7)

He met with the **other** players from his team in the morning, and **together they** arrived at the stadium. Even **through** the stress **they** were still determined to win. (4)

After the game was over he struggled to **breathe**, but **together they** won indeed! The training has proved successful, and **both** of his parents were very proud. **Thanks** to practising he became a serious **threat** to every **other** team in the league. (7) (overall 31)

Individual sentences

1. Eva was, in **truth**, a great **mathematician**
2. She danced to the **rhythm**.
3. It is **maths** that she **loathes**.
4. She **thought** that she should get some more **clothes**.
5. He did **everything** and didn't even get a **thanks**.
6. David **bathes three** times a week.
7. The movie was **something** of a great **thriller**.
8. The **moths** went **through** the fire.
9. Her **clothes** took his **breath** away.
10. He stank, and wouldn't take a **bath** for **months**.
11. He would **sunbathe** at the beach.

12. She did **maths** well.
13. They wanted to **bathe** for hours.
14. I had to **clothe** my old grandma.
15. The **thing** went missing for **months**.
16. the book's **author** probably **loathes** letting his characters live.
17. but I want to **sunbathe**!
18. The **months** since his **death** were strange.,

Appendix 2 - The interviewing questions and script

Hello and welcome, how are you feeling today?
…….
How old are you?
What would you say that your level of English is, how good at English are you?
How much do you use and expose yourself to English in your day-to-day life? Do you watch content in English, play video games, chat in English, or anything like that?
Have you ever been to an English speaking country?
Have you ever been in prolonged contact with a native speaker of English?
…….
Ok, now I will ask you to read the text here, read it for yourself first, and when you're ready, you can read it out loud. The reading will be recorded for research purposes. Do not worry, it will be anonymized.
If you do not know how to pronounce a word, just pronounce it as you think it would be. If you get stuck or make a mistake, make a pause, and then read the sentence again.
Do you understand the instructions?
(if they don't, ask them again, if they do, proceed to next step)
You may begin, let me know when you have read the text, so we may start the recording.
…………….
I will start the recording now…you may begin reading out loud.
……………..
Thank you very much, have a great day

Appendix 3 - Spreadsheets with the results

Voiced consonants:

voiced	speakers:																									
initial	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**	**S14**	**S15**	**S16**	**S17**	**S18**	**S19**	**S20**	**S21**	**S22**	**S23**	**S24**	**S25**	**S26**
initial solo																										
they arrived 8	d	d	d	d	d	d	d	d	d	ð	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
they were still 9	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
they won indeed 11	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
There was 4	d	d	ð	d	ð	d	d	d	ɖ	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
then he went to sleep 7	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	ð	d	d	d	d	d	d	d	d	d	d
medial																										
his **father's** (2)	d	d	ð	ð	d	ð	d	ʔ	d	d	ɾ (alveolar tap)	ɾ (alvec	d	ɾ (al	ɾ (al	ɾ (al	ɾ (al	d	d	d	d	ɾ (al	d	d	d	d
his **mother** has 4	d	d	ð	d	d	ð	d	ɾ (al	d	ð	ɾ (alveolar tap)	ɾ (alvec	d	ɾ (al	d	ɾ (al	ɾ (al	d	d	ɾ (al	d	ɾ (al	d	d	d	d
although he was tired (3)	d	t	ð	d	d	ð	d	d	d	ð	d	d	θ	t	d	ð	d	t	d	t	d	d	t	d	d	t
to the **rhythm** 2	θ	d	ð	ð	ð	ð	θ	θ	θ	ð	θ	d	ð	ð	ð	ð	ð	th	ð	t	t	t	t	Con	t	t
the **other** players 8	d	d	d	d	ð	d	d	d	d	ɾ (a	-	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
every **other** team 13	ð	d	d	d	d	d	d	d	d	ð	ɾ (alveolar tap)	d	d	d	d	ɾ (al	ɾ (al	d	d	ɾ (al	d	d	d	d	d	d
but **together** 11	d	d	d	d	d	ð	d	d	ð	ð	d	ð	d	d	d	ɾ (al	ɾ (al	d	d	ɾ (al	d	ɾ (al	d	d	d	ð
and **together** 8	d	d	d	d	ð	d	d	d	d	ɾ (a	-	d	ɾ (al	ð	d	ð	ɾ (al	d	d	d	d	ɾ (al	d	d	d	d
final solo																										
he struggled to **breathe** 10	ð	v	v	v	ð	ð	f	-	ð	ð	v	v	ð	v	ð	ð	v	θ	d	d	v	ð	d	v	t	ð
wanted to **bathe** for hours 13	ɖ	d	f	f	ð	θ	v	tʃ	θ	ð	θ	θ	θ	f	ð	f	f	f	t	tʃ	v	d	d	f	d	d
would **sunbathe** 11	θ	f	ð	v	ð	θ	f	f	θ	ð	f	θ	θ	v	ð	θ	f	θ	t	t	v	d	d	f	d	t
I want to **sunbathe** 17	θ	t	f	f	ð	θ	v	v	θ	ð	ð	f	θ	f	ð	v	f	f	d	t	v	v	d	v	t	v
I had to **clothe** my 14	t	v	ð	v	ð	θ	v	t	θ	θ	ð	θ	θ	s	t	v	Com	d	t	t	θ	v	d	v	t	d
final cluster with s																										
some new **clothes** 5	-	t	-	-	-	-	-	-	-	t	-	t	-	f	-	-	t	t	-	t	v	-	d	-	d	d
get some more **clothes** 4	-	d	-	v	-	ð	-	t	-	t	θ	d	-	f	t	v	-	-	d	t	-	v	d	-	d	ð
her **clothes** 9	d	d	-	-	-	ð	-	t	-	t	θ	t	t	t	t	d	-	d	-	t	v	-	d	-	d	d
she **loathes** 3	t	d	-	f	d	ð	-	t	d	d	-	t	t	th	t	v	t	t	-	t	t	-	d	v	t	d
probably **loathes** letting 16	t	d	-	f	-	ð	-	t	d	t	-	θ	-	th	t	f	t	t	t	t	d	t	d	v	-	d
david **bathes** 6	t	f	-	f	ð	θ	f	tʃ	v	t	f	t	θ	t	-	v	v	d	d	tʃ	v	t	d	v	d	d

Voiceless consonants:

voiceless	speakers:																									
eng level	3	3	3	2	3	2	2	2	2	3	3	3	1	1	3	3	2	1	3	1	2	2	3	2	2	:
initial	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**	**S14**	**S15**	**S16**	**S17**	**S18**	**S19**	**S20**	**S21**	**S22**	**S23**	**S24**	**S25**	**S26**
initial solo																										
Thanks to practicing 12	t	f	θ	f	θ	θ	t	t	θ	t	θ	t	t	t	t	θ	t	t	t	f	t	t	t	t	t	t
get a **thanks** 5	θ	f	f	θ	θ	θ	f	f	θ	t	t	θ	t	t	θ	f	θ	t	t	f	f	f	t	t	t	t
he **thought** that (3)	t	t	θ	f	θ	θ	f	d	d	θ	θ	θ	t	t	t	θ	θ	t	t	t	t	d	t	t	t	t
She **thought** 4	t	t	θ	f	θ	θ	f	d	t	θ	t	θ	t	t	t	θ	t	t	t	t	t	t	t	t	t	t
The **things** like (1)	t	f	f	f	t (dent)	θ	f	f	t	θ	θ	t	t	t	θ	s	t	t	t	t	θ	t	t	f	t	t
the **thing** went 15	t (dent)	f	θ	f	θ	t	f	f	θ	t	θ	t	t	t	θ	θ	θ	ts	t	t	f	f	t	f	t	t
a chicken **thigh** 6	t	f	θ	f	θ	θ	θ	t	θ	θ	t	t	t	t	t	θ	t	t	t	t	t	t	t	t	t	t
initial cluster with r																										
He pushed **through** (2)	θ	t	θ	f	θ	θ	θ	θ	θ	t	t	t	θ	tʃ	tʃ	t	tʃ	t	t	t	t	t	t	f	t	t
through the fire 8	t	t	θ	f	θ	θ	f	θ	θ	θ	t	t	t	tʃ	tʃ	t	t	θ	t	t	t	t	t	f	t	t
of a great **thriller** 7	t dent	t	θ	f	θ	θ	f	t	t	θ	θ	t	t	θ	t	t	f	t	t	t	f	t	t	t	t	t
three dumplings 7	t	f	f	f	θ	θ	f	t	t	t	θ	θ	t	t	t	θ	tʃ	θ	t	f	t	t	t	t	t	t
three times a week 6	t	f	f	f	t	θ	f	t	θ	t	θ	t	t	tʃ	tʃ	t	tʃ	s	t	f	f	t	t	t	t	tʃ
a serious **threat** 13	θ	f	θ	θ	θ	θ	f	θ	t	θ	θ	θ	t	θ	θ	θ	tʃ	t	t	t	t	s	t	t	t	t
medial																										
a great **mathematician** 1	t	t	θ	t	t	θ	f	t	θ	θ	t	θ	t	t	t	f	t	t	t	t	t	th	t	t	t	t
he did **everything** 5	t	f	f	f	θ	θ	f	f	θ	t	f	θ	θ	f	θ	θ	f	t	t	f	f	t	t	t	f	t
was **something** 7	t	f	θ	f	t	θ	f	f	θ	t	f	t	t	p	t	θ	θ	t	t	t	f	t	t	f	t	t
nothing 4	t	f	f	f	θ	θ	f	f	θ	θ	θ	t	t	f	θ	θ	f	f	t	f	f	f	t	f	f	θ
book's **author** probably 16	t	d	θ	f	ð	θ	ɾ (al	th	θ	x	θ	θ	θ	t	t	t	tʃ	t	t	t	t	th	t	t	t	t
the **athlete** was (1)	t	t	f	t	t	f	t	t	θ	θ	θ	t	t	f	t	t	θ	t	t	t	t	t	t	t	t	t
methods (2)	t	t	θ	t	θ	θ	t	t	t	t	θ	d	t	t	t	θ	θ	t	t	t	t	t	t	t	t	t

final																										
final solo																										
his **breath** away 9	d (dent)	t	θ	f	θ	θ	f	f	f	θ	θ	θ	θ	f	t	θ	f	θ	t	θ	f	θ	d	f	t	ð
He took a **bath** 6	t	f	f	f	θ	θ	f	f	θ	θ	θ	θ	θ	f	θ	θ	f	f	t	f	f	f	-	f	t	θ
wouldn't take a **bath** 10	t (dent)	f	θ	f	θ	θ	f	f	θ	θ	θ	θ	f	f	θ	f	f	f	t	f	f	t	d	f	t	t
felt like **death** (2)	t	t	θ	θ	θ	θ	f	f	f	-	θ	θ	t	t	θ	θ	f	f	t	t	f	f	θ	f	t	t
his **death** were 18	t	t	θ	θ	θ	θ	f	v	θ	θ	θ	θ	d	t	t	t	t	t	t	t	t	f	t	f	t	d
in **truth** 1	t	f	θ	f	θ	θ	f	θ	θ	θ	θ	tʃ	θ	t	tʃ	tʃ	θ	f	t	t	t	t	t	t	t	t
and **both** his parents 12	d	f	v	f	f	f	f	f		θ	t	θ	t	f	d	θ	h	t	t	t	f	t	t	f	d	t
final cluster with s																										
He trained for **months** (3)	-	t	-	-	-	θ	-	-	-	-	θ	-	-	-	-	-	-	t	-	-	-	-	-	-	-	-
for **months** 10	-	-	-	θ	-	-	-	t	-	d	-	-	-	-	-	-	-	-	-	θ	f	-	-	-	-	d
missing for **months** 15	-	-	-	-	-	-	-	t	-	-	-	-	-	-	-	-	-	-	-	t	-	-	-	-	-	t
The **months** since 18	-	t	-	-	θ	-	-	-	-	-	d	-	-	-	-	-	-	-	-	-	-	-	-	-	-	d
it is **maths** 3	d	f	θ	-	θ	θ	v	f	θ	d	-	f	t	f	t	-	-	f	-	t	f	t	d	f	t	θ
did **maths** well 12	d	d	-	-	θ	θ	f	f	θ	t	θ	t	t	f	-	-	-	θ	t	t	f	t	t	f	d	-