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## TRABAJO DE FIN DE GRADO

### A Study of the Assimilative Behavior of the Voiced Labio-Dental Fricative in American English

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## ABSTRACT

Gradation is one of the main features of colloquial speech. It implies the presence of certain phonological processes that ease the transition between phonemes with different articulatory features. For English, one of these implied processes is assimilation, which is when the articulation of a segment is modified into another one already existing in the system. Our study takes Gimson (1994)'s suggestion that /v/ assimilates into /m/ when it is followed by the bilabial nasal. After observing and describing different cases of assimilation, we suggest more possible explanations to this phenomenon and more assimilative behaviors of /v/. Therefore, we conduct an experiment with six American-English L1s where they evaluate sentences whose articulation includes our suggested proposals. The results show Gimson's theory not to be as accurate as expected. Furthermore, we prove that /v/ can assimilate into /b/, /ʒ/ and /d/ when it is followed by bilabial, velar and alveolar phonemes.

*Keywords:* assimilation, phonological processes, labio-dental fricative, articulation, connected speech.

## RESUMEN

La gradación es una de las características más significativas del lenguaje coloquial. Esta implica la presencia de ciertos procesos fonológicos que facilitan la transición entre fonemas con distintas articulaciones. En el caso del inglés, uno de estos procesos es la asimilación, que consiste en cambiar la articulación de un segmento por la de otro existente en el sistema. Este estudio se basa en la propuesta de Gimson (1994), por la que /v/ se asimila a /m/ cuando le sigue la bilabial nasal. Tras observar y describir más casos de asimilación, nos planteamos distintos comportamientos asimilativos de /v/ en este y otros contextos, que fueron evaluados por medio de un experimento realizado a seis nativos de inglés-americano. Los resultados muestran que la teoría de Gimson no es tan apropiada como se esperaba. Además, concluimos que /v/ puede asimilar a /b/, /ʒ/ y /d/ cuando le siguen ciertos sonidos bilabiales, velares y alveolares.

*Palabras clave:* asimilación, procesos fonológicos, fricativa labiodental, articulación, habla conectada.



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## 1. Introduction

The description of a language's speech features is a common goal for many current studies. Finch & Ortiz-Lira (1988), Gaskell (2003), Markó et al. (2010), Gimson (1994) and Roach (1991), among others, are some well-known authors who have been working on the description of English speech processes. However, the continuous development of language production provokes an increasing number of new situations and contexts affected by these processes that have not been described or fully studied yet. In addition, the differences between spontaneous or read speech (Markó et al., 2010) imply more difficulties in this language description task. A segment with a certain phonemic transcription can have more than just one phonetic description,<sup>1</sup> which is usually connected with speech processes. Whereas read speech implies a carefully articulation of said segment, spontaneous speech corresponds to the speakers' individual style. Therefore, the representation and description of this large variety of styles is very difficult.

Spontaneous speech is characterized by automaticity and fast speed, which implies the presence of connected speech processes. Some of these processes provoke the elision of phonemes (elision), the addition of sounds to make easier the transitions from a phoneme to another (epenthesis), or the change of articulatory features also to ease transitions. Assimilation is included in this last type of processes, and it is considered in turn "representative of a number of connected speech phenomena" (Gaskell 2003). It is defined as the modification of a phoneme's place of articulation by that of its following or preceding sound. The change of its articulatory features implies the assimilation of the features of another phoneme already existing in the system. Although it is a very frequent process and it affects a lot of phonemes, studies on assimilation remain focused on assimilative processes in general, and scarce in describing precise contexts.

Gimson (1994), on the other hand, describes a case of assimilation that is not commonly mentioned by other authors. He refers to assimilation involving nasality, as in *give me*. In this context, the phoneme /v/ changes into /m/ according to his theory. However, the afterwards detailed description of this specific context makes us think that

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<sup>1</sup> While a phonemic transcription of a segment contains the mental categories of the sounds (phonemes), a phonetic transcription represents how sounds are actually reproduced.

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there may be more assimilative behaviors of /v/ that explain the phonetical link between both words. Moreover, if assimilation affects this type of segments, it could also work in other contexts that have similar characteristics, like segments including nasals or bilabials, or segments with different phonemes that may undergo similar processes.

Therefore, in the present study, an experiment has been carried out in order to get some conclusions on the description of the assimilative behavior of /v/ in American-English colloquial speech. This experiment is based on a perception task carried out by American-English native speakers who have been asked to point out any pronunciation inaccuracy they may detect. Raters have listened to some recordings of a non-native speaker producing some prepared sentences containing the different discussed assimilative behaviors of /v/.

Before addressing the experiment, the present study will firstly present a general approach to assimilative processes, as well as a detailed description of Gimson (1994)'s theory and our suggested different assimilative behaviors of /v/. Then, it will offer an exhaustive description of the conducted experiment previously mentioned. After the task has been completed by the raters, results will be studied, and will be presented and discussed hereby. The results that we will get from the experiment will probably lead us to some conclusions about how assimilation works in American-English speech. So, at the end of this study, the assimilative behavior of /v/ in American colloquial speech may be described.

### **2. Contextualization: Assimilation processes in English**

Markó et al. (2010) study the differences between two speech styles: spontaneous speech and read speech, considering features as voicing assimilation. They state that the automaticity on articulation is the key element that makes these styles differ. This automaticity makes the speaker pay very little attention to the articulation of the sound, triggering processes such as assimilation.

Assimilation is defined as “the process by which sounds are influenced by neighboring sounds and come to share some or all of their phonetic characteristics” (Finch & Ortiz-Lira, 1988, p. 77), in order to adjust and make easier the transition to the following sound (regressive assimilation), or to the preceding one (progressive assimilation).



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- (1) *That boy* /,ðæt 'bɔɪ/ → [,ðæp 'bɔɪ]<sup>2</sup>  
 (2) *Bacon* /'beɪkn/ → ['beɪkŋ]

Example (1) is an instance of regressive assimilation. /t/ and /b/ are two phonemes with different places of articulation, as /t/ is an alveolar sound while /b/ is bilabial. Therefore, /t/ modifies its place of articulation into the bilabial /p/ which is also a plosive consonant, so the articulation of the following sound is easier and faster. On the other hand, example (2) is an instance of progressive assimilation. It also contains two phonemes with different places of articulation, as /k/ is a velar sound and /n/ is an alveolar one. The tongue modifies its position from the expected alveolar point of articulation of the /n/ into a velar position. Thus, the transition from the /k/ is more accessible. In addition, Gow (2003) argues that, in some contexts, “the same stimuli can produce both regressive and progressive effects, suggesting that the two effects may occur together”; although when a segment changes its place of articulation due to assimilation, “progressive effects appear early and before regressive effects” (as cited in Gow & McMurray, 2007, p. 7).

These two different types of assimilation are also described and studied by Gow & McMurray (2007). In their study, these authors describe the assimilation that happens in a coronal place (alveolar phonemes), focusing on the differences between regressive and progressive assimilation. They conclude that assimilated segments do not always lose their properties, but they sometimes also share characteristics with the affecting segments (p. 20). In example (1), the affected /t/ still maintains its plosive features after assimilation, as well as how in example (2), the /n/ continues to be a nasal sound. Roach (1991) also supports this idea, that “the consonants that have undergone assimilation have *not* disappeared” (p. 125). Gaskell (2003) also suggests that “there may be nonetheless subtle traces of the underlying gesture in a superficially fully assimilated segment” (p. 2). All these scholars agree therefore with the idea that an assimilated sound maintains some of its features in a way.

Gaskell (2003) also identifies different types of assimilative processes that segments can undergo. His classification is based on the segments’ place of articulation,

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<sup>2</sup> Examples are going to be accompanied by the phonemic transcription inside slashes, and the exact phonetic pronunciation transcription in square brackets.

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manner of articulation and voicing. Related to the first feature, Roach (1991) discusses the assimilative process that happens to alveolar phonemes followed by non-alveolar ones as the “most clearly observable” (p. 124), example (3) below. The assimilation of manner is also reduced to plosives that adopt fricative or nasal features, example (4). Finally, he limits voice assimilation to cases in which a final lenis (voiced consonant) is followed by an initial fortis (voiceless consonant), as in example (5). As we can see, the possibility of an assimilative behavior of /v/ preceding bilabials is not considered by Roach (1991).

- (3) *That person* /ðæt 'pɜ:sən/ → [ðæp 'pɜ:sn]
- (4) *Good night* /'gʊd naɪt/ → ['gʊn naɪt]
- (5) *Dogs* /dɒgz/ → [dɒgz]

Roach (1991, p. 124-126)

Furthermore, scholars like Bloch in the middle of the 20<sup>th</sup> century study phonemic overlapping as a consequence of assimilative processes and differentiate two types. On the one hand, *partial overlapping* occurs when a phoneme under two different contexts is given two different sounds. Bloch (1941) provides some examples of this type of overlapping. One of them has to do with the alveolar flap [ɾ]. Whereas it is included as an allophone of the phoneme /t/ when it is intervocally and after a stressed syllable (*kitty*), it is also an allophone of the phoneme /t/ when it goes after dental sounds (*three*). However, this coincidence does not imply comprehensive ambiguity, and therefore it is considered a case of partial intersection or overlapping. On the other hand, *complete overlapping* happens when similar phonetic conditions are represented by different phonemes. An instance of this type of intersection deals with weak vowels. “On the basis of phonetic similarity and pattern congruity” (p. 6), Bosch (1941) considers that the unstressed vowel of *at* in *at home* should be identified with the stressed vowel of *cut*, *come* and *rush*. At the same time, the weak vowel of *at* is identified with the stressed vowel of *cat* in contexts such as *where at*. Hence, the unstressed vowel of *at* in *at home* [ʌt 'hʊm] happens in the same phonetic conditions of the stressed vowel of *at* in *where at* [wɛər 'æt], as they alternate in complementary situations. Therefore, “the same phonetic conditions have been assigned to different phonemes” (p. 6), [ʌ] and [æ] (*at home* vs. *where at*), when they occur in the same conditions; taking into account that Bosch (1941) considers that “stress in English is phonemic (distinctive)” (p. 5). The concepts of partial and complete overlapping will be relevant in the study of our results.

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Moreover, Gow & McMurray (2007) consider assimilation important not only from a phonetic point of view, but also in lexical terms. As they explain, assimilation can produce lexical ambiguity “to the degree that it neutralizes phonetic contrasts in some environments” (p. 3). Gaskell (2003) describes different degrees of assimilation and their consequences based on responses to a discrimination task. He found that assimilations involving non-alveolar phonemes (i.e. strong assimilations) “generate a high level of ambiguity for the listener” (p. 449).

However, assimilation is not the only process present in fast and colloquial speech. English language is eminently characterized by the process of gradation, which consists on the “change in phoneme realizations produced by changing the speed and casualness of speech” (Roach, 1991, p. 127). This feature boosts processes such as accommodation, assimilation, elision, or coalescence. Hence, while assimilative processes are analyzed, similar processes can appear in this type of speech. Accommodation refers to the allophonic variations studied by Gimson (1994). One of these variations is based on the modification of the place of articulation in order to ease the transition to the following segment.<sup>3</sup> Example (6) is an instance of dental accommodation. Elision consists on the omission of sounds in fast colloquial speech. The elision of sounds in words that have a weak form<sup>4</sup> is very frequent, as seen in example (7). Roach (1991) also refers to this process as “zero realization” (p. 127). He includes several types of elision including the “loss of final v in ‘of’ before consonants” (p. 127). Finally, coalescence refers to the process by which two sounds from different segments fuse and are substituted by one which shares some of the articulatory features of the substituted ones. It is mostly found when /t, d, s, z/ are followed by /j/. The resulting sounds are /tʃ, dʒ, ʃ, z/ respectively. It is also a feature that normally appears in fast colloquial speech. Some examples of this process are presented by Gimson (1994, p. 260) and can be seen in examples (8) to (11).

(6) *One thought* [,wʌŋ̥ 'θwɒ:tʃ]

(7) *Could* /kʊd/ → [kd]

<sup>3</sup> See *Gimson's Pronunciation of English* (1994) for further information on accommodation or allophonic variations.

<sup>4</sup> Function words usually have two different realizations depending on stress. If they are stressed syllables, the strong realization is normally the preferred, which may coincide with the actual phonemic description. On the other hand, the weak form is produced when these words are unstressed. In example (7), we can see an instance of this type of words.

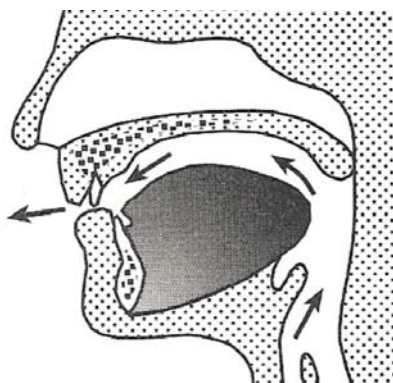
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- (8) *What you want?* /wɒtʃu: 'wɒnt/  
 (9) *Would you?* /'wʊdʒu:/  
 (10) *In case you need it* /ɪŋ keɪʃu: 'ni:d ɪt/  
 (11) *Has your letter come?* /hæʒɔ: 'letə kʌm/

### 3. Assimilative behavior of the voiced labio-dental fricative /v/

Gimson (1994) and Chomsky & Halle (1991), together with the scholars mentioned in the previous section, study different types of assimilation and the contexts in which it can occur, as the ones in examples (1) to (5). As it has been previously mentioned, the assimilative behavior of /v/ will be observed in detail hereby. Gimson (1994)'s theory on this concrete context of assimilation will be firstly reviewed afterwards.

To begin with, the voiced labio-dental fricative /v/ is a phoneme articulated with the velum up and little contact between the lower lip and the upper front teeth. Figure 1 shows a representation of /v/ articulation. Although, as Jansen (2007) states, “the [+voice] fricatives of English and similar languages are able to trigger regressive voicing assimilation” (p. 3), a scarce number of scholars study voiced labio-dental fricative assimilation. Hence, in the present study, we will consider how /v/ assimilates when it is preceded by phonemes with different places of articulation, like bilabial, alveolar and velar sounds; considering Gimson (1994)'s theory as our main baseline.



Gimson (1994, p. 166)

Figure 1: *The articulation of /v/.*

In his description of English pronunciation, Gimson (1994) considers that the Received Pronunciation (RP) assumption of what is considered standard in English is “the

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result of a social judgement rather than of an official decision as to what is ‘correct’ or ‘wrong’” (p. 78). He describes assimilation that involves nasality, which is very frequent in rapid speech but not as acceptable in RP. Among the different instances that he provides of this type of assimilation, we can find voiced labio-dental fricative assimilation before the bilabial nasal. According to Gimson (1994), the articulation of /v/ undergoes an instant of anticipation in which the velum is down, feature that corresponds to nasal phonemes.

(12) *Give me that folder!* /'gɪv mi ðæt ,foʊldər / – ['gɪmmɪ ðæt ,foʊldər]

Example (12) could be an instance of this theory. The issue is that the labio-dental fricative anticipates the lowered soft palate position (regressive assimilation), which corresponds to the following nasal sound /m/. This repeated consonant that appears after the assimilative process provokes the gemination<sup>5</sup> of the /m/ sound when it is pronounced. This means that the double consonant is uttered as a long /m/. Bearing in mind that vowels are usually nasalized when the adjacent sound is a nasal phoneme (Ladefoged, 1975, p. 33-36) and that, after the assimilative process, the stressed vowel of *give* is followed by the nasal sound /m/, said vowel also becomes nasalized.

However, several studies, such as Bloch (1941)'s, have shown that it is impossible to produce an utterance in the same way twice. Therefore, it seems very difficult to limit this assimilation process to just one explanation. Several aspects of speech related to the assimilation of /v/, that are going to be analyzed hereafter, and some examples of English speech, such as *o'clock*, have suggested that Gimson's explanation of this particular case of assimilation may not be the only possibility. In the same way, it may not be the only context in which /v/ presents an assimilative behavior. Therefore, different alternatives and contexts will be observed. These different perspectives have been reached through a process of observation of different parts of fluent and casual speech and an analysis of their pronunciation.

The first different alternative to Gimson (1994)'s theory is the pronunciation of /v/ as /b/, which can be seen represented in example (13). In fast speech, the linking

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<sup>5</sup> Gemination occurs when there is “a sequence of two identical, or nearly identical consonantal sounds. Examples of such sequences are observed in such English sequences as [kk] in *book-case*, [dd] in *bad dog*, [ss] in *this set*, [nn] in *unknown*, etc.” (Catford, 1988, p. 111). It implies one single closure for the two segments, one single compression of double duration, and one single release.

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between a word ending in /v/ and a word beginning with a bilabial may conclude in a process of assimilation due to several issues that will be now discussed. It should be taken into account that the labio-dental and bilabial sounds share a similar point of articulation, as both present a labial implication. This similarity may also lead to the pronunciation of /v/ as /b/, which also seems possible applied to any context in which /v/ is followed by the bilabial plosives /p, b/. The change into /b/ before /m/ goes hand in hand with a shift from a fricative sound to a plosive sound, which provokes a great difference between these two phonemes and could become an impediment for this assimilative process, as it could sound strange or unnatural. Fricatives imply a process of air moving through the mouth, as there is no complete closure. Differently, plosives imply a complete closure of the lips, so there is no air moving through the mouth, but a compression of it behind the bilabial closure. However, due to the following bilabial nasal sound /m/, the bilabial plosive suffers a process of homorganic nasal release<sup>6</sup> which avoids this bilabial plosion and makes possible the assimilation.

(13) *Could you give me that folder?* /kʊd ju: 'gɪv mɪ ðæt ,fəʊldə/ – [kʊd ju: 'gɪb<sup>m</sup> mi ðæt ,fəʊldə]

Furthermore, if /v/ changes into /b/ when it is followed by the bilabial nasal /m/ to ease the transition from one phoneme to the other; it seems probable that /v/ could also assimilate into /d/, which is also a voiced sound, when it is followed by the nasal /n/. The alveolar nasal and the alveolar plosive share its place of articulation, so the transition from one to the other would be easier than maintaining the /v/. Again, the nasal release avoids the plosion of /d/ which helps the assimilation. This assimilative behavior of /v/ can be seen in example (14).

(14) *They have none* / ðeɪ hæv 'nʌn / – [ðeɪ hæd<sup>n</sup> 'nʌn]

Due to similarities in place of articulation, /v/ may also be assimilated in contexts where it is followed by the voiceless alveolar plosive /t/ as it may change into /d/ too. /t/ and /d/ are both alveolar plosives, which would lead to assimilation of /v/ as a way of

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<sup>6</sup> Nasal Release is a process that occurs when a plosive is followed by a nasal sound. The plosive adapts its place of articulation lowering the velum and letting compressed air to flow out through the nasal cavity. Then, the transition from the plosive to the nasal is easier.

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easing the transition from one phoneme to another. We can see a case of this context in example (15).

(15) *We **have to** support our team* /wi: hæv tu: sə'pɔrt əv ti:m/ → [wi: hæd tu: sə'pɔrt əv ti:m]

On the other hand, we can find examples in English in which the sound /v/ becomes elided or is substituted due to a process of gradation. English expressions such as *o'clock*, *cat o' nine tails*, or *man o' war* present said feature. The word *of* /əv/ has been reduced to the sound /ə/. Hence, we could also presuppose that the sentence in example (13) may have the sound /v/ of *give* elided. However, in the aforementioned expressions, /v/ corresponds to a function word which may limit its elision just to this type of words and not to some others such as *give* in example (13), which is a content word. For this reason, the sound /v/ may not be elided but substituted by a glottal plosive, which consists on the airstream obstruction “formed by the closure of the vocal folds, thereby interrupting the passage of air into the supraglottal organs. The air pressure below the glottis is released by the sudden separation of the vocal folds” (Gimson, 1994, p. 154). Thus, what is perceived is a period of silence. A representation of this alternative is presented in example (16).

(16) *Could you **give me** that folder?* /kʊd ju: 'gɪv mi ðæt ,fɔldə/ – [kʊd ju: 'gɪ̥ mĩ ðæt ,fɔldə]

Furthermore, considering that *give* may be pronounced as [gɪb] or as [gɪ̥] due to two different behaviors of /v/, we could also consider that in the example *o'clock*, the /v/ may not be phonetically elided, as was in [gɪb]. Therefore, the labio-dental fricative /v/ may be pronounced as /g/ due to a process of assimilation, as it can be seen in example (17). Nevertheless, due to the same relation between these different contexts, /v/ may also be modified into /ʀ/ when it is followed by /t, k, n/, as the period of silence during the production of a glottal stop could ease the transition from /v/ into any of these three sounds. An instance of this process can be seen in example (18).

(17) *I'm afraid **of** cats* /aɪm ə ,freɪd əv 'kæts/ – [əɪm ə ,freɪd ə̥ 'kæts]

(18) *It is a **cave of** native tribes* /ɪt ɪz ə keɪv ʌv neɪtɪv traɪbz/ – [ɪt ɪz ə keɪv ʌ̥ neɪtɪv traɪbz]

#### 4. Aim of the study

An exact transcription of a part of colloquial speech is a difficult task. In the previous section, different possible realizations of the voiced labio-dental fricative have been studied according to its possible contexts. The observation of native-like utterances has suggested that /v/ may be altered by its following sounds. /v/ seems to assimilate when it is followed by bilabial, velar and alveolar plosives; and by the nasal phonemes /n, m/.

Therefore, the aim of the present work is to study whether /v/ may be affected by assimilative processes that change it from its expected labio-dental position. By analyzing different contexts in which this process may appear, a more accurate description of the assimilation of /v/ could be reached. Hence, an experiment has been carried out in order to check if the mentioned assimilative behaviors of /v/ are noticed by American native speakers.

#### 5. Methodology

Gaskell (2003) states that “assimilated consonants contain information suggesting two places of articulation, relating to both the word final consonant and the following consonant” (p. 5), which may be essential in the perception of this process. If an assimilated sound contains information on both affecting and affected phonemes, assimilation may not necessarily be noticed and both phonemes could be inferred. However, if this assimilation results in a non-native like segment, it would be noticed.

Hence, the different proposed assimilative behaviors of /v/ have been tested through an experiment, in which American native speakers have evaluated the acceptance of these processes in different contexts. The experiment is based on an audio task, which consists on the recordings of several sentences including said behaviors and which is accompanied by a visual representation of the recorded material.

This experiment is aimed at the perception study, particularly, at the perception of the assimilation process in colloquial and fast speech. Therefore, six raters have been provided with the audio task, which is part of a transversal study, as they have been tested just once. Moreover, some of them have been supervised while completing the task and others have carried out it online. They have had to note any pronunciation inaccuracy they could detect in the recordings.



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**5.1.Participants**

Raters are all American native speakers from Wisconsin, New York, Minnesota and California. Therefore, their L1 English variety is American English. As Gimson (1994) states regarding changes in phonetic place of articulation, “native speakers are usually unaware that they are made” (p. 259). This justifies the selection of native speakers for this experiment. The issue is that, if they were unaware of an assimilative process, it would mean that from a native point of view this specific segment allows assimilation. On the other hand, if they pointed out that there is something inaccurate in the pronunciation, it would mean that this context does not allow an assimilated sound.

Dealing with personal information, the age range of the group is 20–40, and the mean age is 23.6. Some of the participants have finished their undergraduate studies and some others are attending university. Most of them have a high developed linguistic awareness due to their studies. Therefore, the ones with a higher linguistic awareness have not only pointed out the inaccurate part of the sentence, but also have added a brief explanation of what they have noticed.

**5.2.Experiment protocol**

For the group of raters who have been supervised, the task has been carried out in a silent room, in order to avoid any noise. Those of them who have participated online have been requested to conduct it in a room as quiet as possible. Furthermore, every rater had to be alone and they have not been allowed to make any search. Since the most important feature of the test data is its belonging to colloquial speech and considering that our purpose is to reach the most natural results, looking for additional information would affect results.

Raters have been given the handout in Appendix (I) which contains a brief introduction with the instructions they have had to follow, as well as the list of sentences they will have to listen to. Firstly, raters have been asked to read carefully and to produce out loud the sentences themselves. This step has been useful to make them conscious of the full meaning of each sentence. The reason is that the rater may consider a sentence to be well pronounced, without wondering if there is a mistake in pronunciation that has altered the actual meaning of this sentence. Then, they have listened to the recordings

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twice with a few seconds gap in between. Raters have been asked to point out any pronunciation inaccuracy they could detect.

They have not been told about the specific purpose of the experiment. This means that they have been informed about the general topic of the experiment, which is pronunciation; but they have not been specified that the task has to do with connected speech, assimilative processes and the assimilative behavior of /v/. They have been told that some of the sentences recorded might contain features of non-native like pronunciation as a way of making them be alert, and that we need their help to recognize non-native productions. They have been asked to be as fastidious as possible. Another given information is that the speaker of the audio is not a native speaker, nor bilingual from birth.

### 5.3. Materials

The audio used for the task has been recorded by a non-native speaker with professional skills on the language, who has been asked to record the prepared sentences including the discussed assimilative behaviors, as well as other pronunciation inaccuracies. In the audio, each sentence is heard twice with a few seconds gap in between. The order of the sentences in the audio is the same as in the written handout.

Appendix (I) is the handout that raters have been provided with. It contains a brief introduction that includes the instructions which have to be followed to complete the task, and the list of sentences they have listened to. The sentences are not organized according to the different assimilative realizations of /v/, as raters may recognize easier what is going on in the experiment. The list of sentences selected for the experiment presents all the possible suggested assimilative behaviors of /v/.

(19) *I love my new mobile case* /aɪ lʌv maɪ nu moʊbəl keɪs/ → [aɪ 'lʌ² mǎi nju moʊbəl keɪs]

(20) *The very best of live music is here* /ðə vɛri bɛst əv pɒp mjuzɪk ɪz hɪr/ → [ðə vɛri bɛst əb pɒp mjuzɪk ɪz hɪr]

(21) *I have cards to play* /aɪ hæv kɑːdz tu pleɪ/ → [aɪ hæŋ kɑːdz tu pleɪ]

(22) *Could you give me that folder?* /kʊd ju ɡɪv mi ðæt 'foʊldər/ → [kʊd ju ɡɪmmɪ ðæt 'foʊldər]

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(23) *Sherlock Holmes is a famous detective* /ʃɜrlək hoʊmz ɪz ə feɪməs dɪtɛktɪv/  
 → [sɜrlək hoʊmz ɪz ə feɪməs dɪtɛktɪv]

There is a group of sentences in which the sound /v/ is assimilated into a glottal stop, example (19), and another group in which the same sound is modified into /b/, example (20). These sentences present the mentioned sound followed by bilabial phonemes. Then, there is another group that contains sentences in which the sound /v/ is followed by the selected velar and alveolar phonemes, example (21). These sentences also include assimilation in the sound /v/, which is pronounced as /d/, /z/ or /g/. Another group of sentences present /v/ sound assimilated following Gimson's theory, example (22). Furthermore, there are also included throughout the experiment some sentences in which the phonetically modified part is not the /v/ sound, but the aspiration of the voiceless /p/, the alteration of vowel articulation, the articulation of the velarized /l/ as a clear /l/, or the wrong articulation of /s/, example (23). These sentences will not be part of our study, but just a way of confounding them and distancing them from the key element of the present study.

#### 5.4.Data selection

Raters have been asked in the experiment to point out any pronunciation inaccuracy they could detect. Although we could expect very different kinds of annotation, all raters have clearly marked the segment that they have recognized as inaccurate. Therefore, we have considered as non-native like segments the ones containing the labio-dental fricative /v/ pointed out.

As it has been previously mentioned, the task includes several sentences that do not include any assimilative behavior of /v/, but any other pronunciation inaccuracy that could be considered, as the lack of aspiration in the initial voiceless bilabial plosive or the change of the palato-alveolar fricative /ʃ/ into the alveolar fricative /s/. These sentences have not been considered in the present study, although they could be useful for further researches on the perception of pronunciation inaccuracies. Similarly, bearing in mind that the speaker in the recordings is not a native speaker, raters have also found more inaccuracies unrelated to the assimilation of /v/. These segments have neither been considered in the present study.

## 6. Results

After participants have completed the task, the results have been gathered and organized in order to study the perception and acceptance of assimilative behaviors by native speakers.

	/v/ → /m/	/v/ → /b/	/v/ → /ɹ/	/v/ → /d/	/v/ → /g/	Total
<b>Accepted</b>	25%	79%	61%	75%	33%	55%
<b>Discarded</b>	75%	21%	39%	25%	67%	45%

Table 1: Overall approach to assimilation perception.

Table 1 shows the percentage of sentences considered non-native like and native-like according to the raters' evaluations, as well as the percentage related to the acceptance of assimilation in general. At the top of the table, we can see that the results are divided according to the phoneme that /v/ changes into due to assimilation. It can be seen that assimilation is not noticed in most cases, although there are differences according to the contexts. When /v/ changes into /m/ (Gimson's perception), raters present certain disagreement and consider this assimilative behavior non-native like. However, there is a 25% of accepted instances; so, this context is going to be observed in detail afterwards. The other assimilative behavior of /v/ that has mostly been discarded is its modification into /g/. Just a 33% of the instances have been considered accepted in colloquial speech. On the other hand, the changes of /v/ into /b, ɹ, d/ are the most accepted ones, mainly into the bilabial plosive /b/. Nevertheless, some differences in each context will be studied.

SENTENCE	N-L		N-N-L	
	n.	r.	n.	r.
You can <b>have mine</b> if you want.	2	33%	4	67%
Could you <b>give me</b> that folder?	4	67%	2	33%
I should <b>save money</b> if I want to travel.	0	0%	6	100%
Could you <b>leave my</b> suit there?	0	0%	6	100%

Table 2: Evaluation results on Gimson's theory.<sup>7</sup>

The present study comes out from Gimson (1994)'s theory on the assimilative behavior of /v/. Since he only studies the context of /v/ preceding /m/, this experiment

<sup>7</sup> Results in Tables 2-4 are expressed both in percentages (r.) and according to the number of raters that have pointed out the segment in question (n.).

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includes some sentences in order to check whether American native speakers accept it or not. Table 2 contains the list of sentences included in the task to test the acceptance of Gimson's perspective. Results are divided depending on whether raters have considered said sentences native like (N-L) or non-native like (N-N-L). As we can see in the table, most cases are considered non-native like. However, in the context *give me*, this type of assimilation has been accepted by four out of the six raters.

As an extension of Gimson (1994)'s theory, this study proposes several different options of assimilative processes. Therefore, there are some sentences including the bilabial nasal after /v/, but also after the bilabial plosives /b, p/. In Table 1, we can see that the voiced bilabial plosive /b/ is less perceived in the assimilative process of /v/ than the glottal stop. Furthermore, the assimilation of /v/ into /b/ or /ɹ/ presents some differences in the context <v> + <b>.

SENTENCE	Realization of /v/	N-L		N-N-L	
		n.	r.	n.	r.
The sense <b>of belonging</b> appeared as soon as I closed the door.	/b/	6	100%	0	0%
Yes, <b>leave both</b> on the table, please.	/b/	5	83%	1	17%
I want a piece <b>of both</b> .	/ɹ/	6	100%	0	0%
Madam, she can <b>have both</b> .	/ɹ/	3	50%	3	50%

Table 3: Assimilative behavior of /v/ before the voiced bilabial plosive.

Table 3 shows the list of sentences included in the task to check the perception of /v/ assimilation before the voiced bilabial plosive /b/. In these cases, the voiced labiodental fricative is modified into /b/ or /ɹ/. The results are again divided into native like (N-L) or non-native like (N-N-L) depending on the raters' evaluation. This table shows that when /v/ is the last phoneme of a function word, as *of*, assimilation is not perceived by native speakers. However, if it is the last phoneme of a content word, raters are more sensitive; although the disagreement is not so notable.

Another subject matter in the present work has to do with the assimilative behavior of /v/ before the selected alveolar and velar phonemes /t, n, k/. This experiment also includes some sentences including this specific context in order to observe if assimilation goes unnoticed in these segments.

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CONTEXT	Realization of /v/	N-L		N-N-L	
		n.	r.	n.	r.
<i>have none</i> /hæv nʌn/	[hæd nʌn]	5	83%	1	17%
<i>have to</i> /hæv tu:/	[hæd tu:]	4	67%	2	33%
<i>have cards</i> /hæv kɑrdz/	[hæɣ kɑrdz]	0	0%	6	100%

Table 4: Assimilative behavior of /v/ before /t,k,n/.

The results, as it can be seen in Table 1, show that /v/ assimilation is accepted if it is modified into /d/, but mostly discarded if it is modified into /g/. Furthermore, a particular case is the segment formed by the verb *have* followed by the named velar and alveolar phonemes. Table 4 contains several instances of this specific segment and its phonetic transcriptions. Moreover, the ‘Realization’ column contains the exact phonetic description after the assimilative process that /v/ undergoes in colloquial speech. The last two columns show the count of native like and non-native like evaluations that each instance has obtained according to the six raters. As it can be seen, assimilation is accepted in the contexts including /v/ plus /n/ and /t/, but raters have discarded unanimously it when /v/ is followed by /k/ and changes into /g/.

SENTENCE	CONTEXT	N-L		N-N-L	
		n.	r.	n.	r.
I <b>love my</b> new mobile case.	/v/ + /m/	3	50%	3	50%
Madam, she can <b>have both</b> .	/v/ + /b/	3	50%	3	50%
If Laura doesn’t answer you, <b>give Peter</b> a call.	/v/ + /p/	6	100%	0	0%
I’m afraid <b>of cats</b> .	/v/ + /k/	5	83%	1	17%
The <b>gave too</b> many presents to her and she didn’t mind so much.	/v/ + /t/	3	50%	3	50%
It is a cave <b>of native</b> tribes.	/v/ + /n/	2	33%	4	67%

Table 5: Perception of the shift from /v/ into /z/.

Table 5 includes the list of given sentences which contained the proposed assimilative behavior of /v/ as glottal stop. The table shows the results obtained in the raters’ evaluation on the pronunciation of /v/ as /z/. As we can see, this shift has been least noticed when /v/ precedes /p/; and most noticed when /n/ follows /v/. However, there are no conclusive results regarding the other contexts.

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SENTENCE	Realization of /v/	N-L		N-N-L	
		n.	r.	n.	r.
The sense <b>of belonging</b> appeared as soon as I closed the door.	/b/	6	100%	0	0%
Yes, <b>leave both</b> on the table, please.	/b/	5	83%	1	17%
The very best <b>of pop</b> music is here.	/b/	3	50%	3	50%
The dove <b>of peace</b> is a very globalized symbol.	/b/	5	83%	1	17%
Total		19	79%	5	21%
I <b>love my</b> new mobile case.	/ɹ/	2	33%	4	67%
If Laura doesn't answer you, <b>give Peter</b> a call.	/ɹ/	6	100%	0	0%
I want a piece <b>of both</b> .	/ɹ/	6	100%	0	0%
Madam, she can <b>have both</b> .	/ɹ/	3	50%	3	50%
Total		17	71%	7	29%

Table 6: Assimilative behavior of /v/ before bilabial plosives.

Since one of the purposes of the present study is to analyze the assimilative behavior of /v/ before bilabial plosives, this experiment includes several sentences including these contexts. Table 6 shows the list of sentences including bilabial plosives that present assimilation of /v/ into /b/ or /ɹ/. It presents the results of each sentence in isolation, as well as the total results after both /b/ and /ɹ/ realizations' groups. The results show that both assimilative behaviors are mostly considered native-like.

## 7. Discussion

The purpose of this study is to analyze the different contexts in which the voiced labio-dental fricative could be assimilated. The carried-out experiment has provided some results that are very significant for said purpose. To begin with, Table 1 in the previous section shows that the suggested assimilative behaviors of /v/ have not been noticed in a 55% of the cases. Kochetov (2008) says that "place-assimilation process is indeed highly variable, both within and across speakers" (p. 3). Therefore, it could be expected that raters' evaluation may vary, as some speakers may produce more assimilated segments and, then, they may not notice them as easily; and some others may not be used to them and they may be more sensitive to this kind of processes. However, taking into account that raters have been asked to be as fastidious as possible, we could say that this

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percentage is high. Considering that no sentence in the task contains the unassimilated phoneme /v/, raters have not noticed the change of phoneme in more than half of the cases, although they were supposed to be alert to any pronunciation inaccuracy. It means that assimilation of /v/ can be considered natural, correct and part of these automatic processes in several contexts, characteristic of English language.

The previously mentioned purpose is originated in Gimson (1994)'s theory of the assimilative behavior of /v/. He only considers this process to be possible when /v/ is preceded by /m/, and he only provides an explanation in which /v/ is modified into /m/ due to assimilation. The results of the experiment in Table 2 show that this shift is mostly evaluated as non-native like by raters. Therefore, it is possible to state that Gimson (1994)'s theory is not the most appropriate one. However, basing on his theory, we have provided in our experiment an example in which this process affects to the segment *give me*. In Table 2, we have observed that four out of the six raters have not noticed the assimilation in that same segment, unlike the other instances of /v/ + /m/. It has to be considered that, in informal English, we can find this segment expressed as *gimme*. Hence, Gimson's perception could make sense. It seems that the phonetic transcription of *give me* as [gĩmmĩ] corresponds to *gimme* in written English. On the other hand, in his study, he provides the segment *have mine* (p. 248) to explain this case of assimilation, which as we can see in the results of Table 2 has been noticed and pointed out as inaccurate.

Nevertheless, this is not the only assimilative behavior of /v/ unnoticed by American native speakers. The assimilated /v/ has been supposed to change for /b/ when it is followed by bilabial plosives. The results in Table 1 show that it is the most unnoticed option, as just 21% of the sentences in which this shift is represented have been pointed out. That can be explained by the similar place of articulation that these two phonemes have. Both have a labial implication at their production. The processes that this change implies, as nasal release, also help to this behavior. Furthermore, the change of /v/ into /b/ can be more detailed. In Table 3, we have seen that the classification between function and content words influences the perception of this case of assimilation. The results show that when /v/ is part of a function word, assimilative processes are not noticed. The function word that has been studied hereby is *of*, as it includes the sound /v/. This word has a weak form when it is unstressed, which sometimes shorten the syllable in colloquial



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speech to /ə/, as it is the case of expressions as *o'clock*. Ortiz-Lira (1976) states that “the weak-form pronunciation of these ‘grammatical words’ (function words) is the usual one in general conversation style” (p. 3). Thus, it can be considered that in the context formed by *of* followed by a bilabial plosive, where /v/ is modified into /b/, the assimilation is not noticed. Speakers may connect this situation to the one of *o'clock*, without noticing that the /v/ has been pronounced as a /b/.

On the other hand, although /b/ is generally the most accepted phoneme in assimilative contexts of /v/, in contexts containing /v/ + /p/, the assimilation tends to be less noticed when the labio-dental fricative modifies into /ɹ/. We can see in Table 6 that assimilation in the sentence including /ɹ/ has not been noticed, whereas /b/ pronunciation has been pointed out. Although either /b/ and /ɹ/ are very similar sounds to /p/, the fact that the latter is voiceless may influence this higher acceptance of the glottal stop, which is also a voiceless phoneme, rather than the voiced bilabial plosive.

Another proposed assimilative behavior of /v/ is found when it precedes the alveolar phonemes /t/ and /n/. In these contexts, /v/ changes into /d/ in order to ease the transition from one phoneme to the other as they share several articulatory features discussed in previous sections. The results have been very favorable, as these segments have been mostly unnoticed, which means that /v/ can assimilate and change into /d/ before the alveolar sounds /t/ and /n/. These results stand out as this phonemic process can change grammatically the sentence. In some of the sentences included in the task, the word affected by assimilation is *have* /hæv/, which is pronounced as [hæd]. This phonetic transcription also coincides with the phonemic transcription of the past tense *had* /hæd/. Therefore, we can perceive an instance of complete overlapping due to assimilation, as both final phonemes in *have* and *had* in the same conditions are pronounced alternatively as /v/ or /d/, without changing the meaning of the sentence. It seems that context may have helped raters to get the expected present tense from other phrases, as they have not noticed that *have* has been pronounced as *had*. In order to avoid the possibility that they may have overlooked this inaccuracy, there are more than just one example containing this behavior; but the results are mostly the same, as it can be seen in Table 4. Comparing assimilation in the contexts /v/ + /n/ and /v/ + /t/, no significant differences have been found, which implies that there is no linguistic relevance.

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Dealing with the assimilative behavior of /v/ that modifies it into /ʒ/, we can see that there are not many conclusive results. Regularly, raters have not noticed this type of assimilation. The reason may be that English native speakers, both British and American, are used to hear periods of silence due to gradation processes, such as elision in function words, as well as they are used to the effect of glottal stops in their colloquial speech. Then, it is not unusual at all that raters have not recognized the assimilative process going on in these segments. However, the percentage of cases in which it has been pointed out is still high. In some cases, this presence of silence of the glottal stop may be the cause of this evaluation as inaccurate. In order to study the assimilative behavior of /v/ by which it is changed into /ʒ/, the voiced labio-dental fricative has been followed by different types of phonemes. If these phonemes have so different articulatory features in relation to the glottal stop, raters may have found inaccurate the realization of these segments. Nevertheless, the difference between noticed and unnoticed cases is not so relevant. There are two cases in which this phonetic change is preferred than others. It is the case of the previously explained segment /v/ + /p/, and the context formed by /v/ + /k/. In the segments following this last pattern, the pronunciation of /v/ as /ʒ/ is preferred than as /g/, as it is going to be discussed afterwards. The reason may be the same than in the case of the /p/. Whereas /k/ and the glottal stop are voiceless phonemes, the velar plosive /g/ is a voiced phoneme. Therefore, /ʒ/ is more unnoticeable than /g/ in these assimilative contexts.

Finally, results have shown that /v/ is not as colloquially assimilated when it is followed by /k/ as in other types of context. In this particular context, it has been proposed a change from the voiced labio-dental fricative to the voiced velar plosive /g/, as they share articulatory features and could be helpful for the transition to the following /k/. However, results in Table 1 show that native speakers normally perceive this change. Therefore, our suggested assimilative behavior of /v/ is mostly not considered native-like. Moreover, in Table 4, we have seen the previously discussed assimilative behavior of /v/ before /t/ and /n/, but also before /k/. The word containing the assimilated /v/ is the same in the three cases, *have*. Hence, we can avoid the possibility that the verb *have* may not access assimilation. Instead, the fact that the change of /v/ into /d/ has been accepted implies that the actual issue is that /v/ changed into /g/ is not as acceptable in American colloquial speech.

### 8. Conclusions and further research

The purpose of this study has been to investigate the assimilative behaviors that the voiced labio-dental fricative can have in American colloquial speech. Hence, we have begun this article by making an overview to the concept of assimilation, as well as to the different types of assimilation and to similar processes that the study of assimilation can imply. Then, Gimson (1994)'s theory on the assimilation of /v/ has been exposed, as it means the main baseline for this study, which tries to expand the scarce theories on /v/ assimilative behaviors. Gimson (1994) refers to the context of /v/ + /m/, in which /v/ is assimilated into /m/. However, several proposals to different assimilative behaviors based on the study of colloquial speech have been suggested. In order to test these hypothetical proposals, an experiment was carried out in which six American native speakers were asked to point out any pronunciation inaccuracy they could detect in the audio recorded by a non-native speaker, who included in his pronunciation of the given sentences the sound /v/ undergoing the different discussed assimilative behaviors.

The first conclusion that we can draw from the results of our experiment is that the voiced labio-dental fricative can present different assimilative behaviors. Raters considered accurate more than half the sentences containing different assimilative contexts tested in the experiment. However, Gimson (1994)'s theory was mostly evaluated as inaccurate except in the previously discussed segment *give me*. As it has been discussed, this segment is sometimes represented as *gimme* in informal writing. Therefore, this can be the cause of Gimson's perception and the acceptance by raters of this particular assimilated segment.

Then, we conclude that /v/ can be assimilated into /b/ and /ʒ/ when it is followed by bilabial plosives. However, we have seen that /b/ is normally preferred, except to the segment /v/ + /p/. The classification of words in relation to their content or function role has seemed also to be influential in the perception of assimilation. Results lead to conclude that it is more unnoticed when /v/ corresponds to a function word than to a content word. As it has been discussed, the possible weak forms in colloquial speech of function words may be the reason of this phenomenon. Then, the modification of /v/ to /ʒ/ was mostly accepted, although there is a high percentage of pointed out cases. However, /v/ is accurately assimilated and changed into /ʒ/ when it is followed by /p/ and /k/, which is another reached conclusion regarding /v/ assimilative behavior. It has been

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discussed that these phonemes share their main articulatory features with /z/, which makes it preferred rather than the assimilation of /v/ into /b/ and /g/, respectively. Another reached conclusion is that /v/ before /t/ and /n/ can be assimilated into /d/, as almost all these segments were not pointed out. However, when it is assimilated into glottal stop, it was more noticed and therefore it is implied that this assimilative context is less natural in American colloquial speech. Finally, we have concluded that /v/ cannot be assimilated into /g/, as raters evaluated this case as inaccurately pronounced.

Although thanks to the carried-out experiment we have been able to reach some conclusions and a more accurate and detailed description of the assimilative behavior of /v/, further work can be made for expanding this work. In the present study, the voiced labio-dental fricative has been tested when it is followed by some selected phonemes. However, for future researches, different phonemes from the selected hereby may be considered, and the tested contexts and segments may be extended in order to get a description that covers a larger number of assimilative contexts. To sum up, the assimilation of /v/ needs to be studied deeper to get the full description of its functioning in American colloquial speech.

## 9. Appendix

### Appendix 1: Raters Handout

Thank you for participating in this project!! Your contribution is essential.

Our purpose is to assess the perception of pronunciation inaccuracies both by human beings and by Automatic Speech Recognition Systems. Please, listen to the audios carefully and circle, upon the written version, any non-native or strange features.

Before listening to each audio, please read the sentence aloud, as naturally as you can, and noticing any relevant grammatical, vocabulary and/or pronunciation features. Then, the audio will be reproduced twice with a few seconds gap in between.

The speaker in these audios is not native, but a specialist in English language. Some inaccuracies might be rather noticeable while other could be very subtle. You will not have to explain or justify your marking. Simply, circle the parts of each passage where you detect anything strange, or wrong, no matter how subtle or difficult to describe. Even if it does not hinder intelligibility. It is also fine if you do not detect anything strange in some of the audios.

Thank you so much for your attention.

- I love my new mobile case.
- She's good at maths; I should ask her for help.
- I want a piece of both.
- You can have mine if you want.
- If Laura doesn't answer you, give Peter a call.
- Madam, she can have both.
- I should save money if I want to travel.
- Come on! Try again. There's enough time.
- Could you give me that folder?
- The sense of belonging appeared as soon as I closed the door.
- The very best of pop music is here.
- Is there any problem if we do the essay together?
- Could you leave my suit there, please?
- Chris is no longer my friend. We had a great argument a few days ago.
- The dove of peace is a very globalized symbol.
- Yes, leave both on the table, please.

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- My children go to the park at least once a day.
- I'm afraid of cats.
- Are you saying that they have the dictionaries? No! They have none.
- Don't say that! No matter what would happen, we have to support our team.
- They gave too many presents to her and she didn't mind so much.
- Sherlock Holmes is a famous detective.
- It is a cave of native tribes.
- I have cards to play.

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