

The Production of English Affricates by Libyan EFL Students: An acoustic study

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Abstract:

The current quantitative and acoustic investigation is an attempt to shed light on the production of English affricates by Libyan students at the Department of English – University of Tripoli. English post-alveolar affricates /tʃ/ and /dʒ/ have no equivalent in the sound system of Modern Standard Arabic or in the Libyan Dialect. According to the Markedness Theory and the Contrastive Analysis Hypothesis, these sounds will constitute a challenge for those learners whose mother tongue does not have these sounds. In order to empirically test these claims, eight Libyan University students in their pre-sessional semester (four females and four males) produced 52 target words (monosyllabic, disyllabic and polysyllabic) with /tʃ/ and /dʒ/ in initial, middle and final position. The aim is to see if the students will undergo the process of deaffrication (the deletion of the plosive component from the affricate). Another aim is to see whether the number of syllables and the position of the affricate within the word will have any influence on accuracy. Results show that both the position of /tʃ/ and /dʒ/ and the number of syllables with the target words have an influence on accuracy. The students employed the process of deaffrication more when the target sounds occurred in final position. In addition, as the number of syllables increased, the percentage of accurate pronunciations decreased. It is hoped that the findings of this study will benefit both: the teachers to adopt appropriate strategies when teaching these sounds, and students to focus more on the production of these sounds.

Keywords: speech production, Libyan EFL students, deaffrication, English Affricates, acoustics.

الملخص :

تهتم هذه الدراسة بأصوات اللغة الإنجليزية المركبة (الانفجارية-الاحتكاكية) كما ينطقها الطلاب الليبيون في قسم اللغة الإنجليزية - جامعة طرابلس. لا يوجد ما يناظر هذه الأصوات في النظام الصوتي للهجات العربية الليبية. ووفقاً لفرضية النقل اللغوي (من اللغة الأولى إلى اللغة الثانية) وفرضية التحليل اللغوي المقارن، ونظرية المفاضلة بين التركيبات الغير نمطية في اللغة الأم واللغة الثانية، ستشكل هذه الأصوات تحدياً لمتعلمي اللغة الإنجليزية والذين لا تحتوي لغتهم الأم على هذه الأصوات. وحتى يتم اختبار هذه الفرضيات بطريقة تجريبية، قام ثمانية طلاب من قسم اللغة الإنجليزية، كلية اللغات – جامعة طرابلس، في الفصل التمهيدي (أربعة إناث وأربعة ذكور) بنطق 52 كلمة تحتوي على أصوات اللغة الإنجليزية المركبة (الانفجارية-الاحتكاكية) في بداية الكلمة ووسطها ونهايتها. وقد احتوت هذه الكلمات على مقطع واحد، أو مقطعين أو أكثر. وكان الهدف من اختيار هذه الكلمات هو معرفة ما إذا كان الطلاب سيقومون بحذف الجزء الأول من الصوت (حذف الصوت الانفجاري) أو الإبقاء عليه. كما تهدف الدراسة إلى معرفة ما إذا كان موقع هذه الأصوات داخل الكلمة وعدد المقاطع فيها سيؤثر على صحة النطق. أظهرت النتائج أن كلاً من موضع الأصوات الانفجارية-الاحتكاكية في الكلمة وعدد المقاطع فيها كان له تأثير على صحة النطق، بحيث زادت نسبة الخطأ في الكلمات التي احتوت على هذه الأصوات في وسط الكلمة ثم نهايتها. بالإضافة إلى ذلك، زادت نسبة الخطأ في الكلمات التي تحتوي على مقطعين. قد تساعد نتائج هذه الدراسة كلاً من الأساتذة في تبني استراتيجيات مناسبة عند تدريس هذه الأصوات، كما ستحفز الطلاب على التركيز أكثر عند نطقهم لهذه الأصوات.

1 Introduction:

During the process of learning English as a foreign language, many Learners encounter several problems and challenges, particularly in speaking. In this context, the main problem lies in the fact that the sound system of the mother tongue and that of the target language are different. For example, when there are certain sounds in the target language that have no equivalent in the mother tongue, it is said that students are likely to face difficulties pronouncing these sounds. These assumptions are based on Lado's (1957) Contrastive Language Learning, which claims that learning a second language is highly determined by what has already been acquired in the first language. This means that what the two languages have in common will be easier to master than those elements where the two languages divert. For example, English vowels which have no equivalent in the sound system of Arabic are going to be difficult to master. This is also the case when it comes to consonant sounds. For example, the voiceless bilabial plosive /p/ has no counterpart in Arabic. As a result, it is

predicted that this phoneme is more difficult to master compared to its voiced counterpart, /b/. This paper aims to test the validity of these claims put forward by “Language Transfer Theory”, “Contrastive Language Learning” and the “Markedness Theory” by conducting an acoustic investigation on the production of English affricates /tʃ/ and /dʒ/ by Libyan university students in their pre-sessional semester. Since these sounds don’t exist in the phoneme inventory of the Libyan Dialect (LD), it is hypothesized that Libyan students learning English as a foreign language (EFL) will not be able to produce these sounds accurately, and that they will resort to a process known as “deaffrication” whereby the plosive element is omitted from their speech. In addition, this paper aims to investigate whether the position of these affricates and the number of syllables within the word will have an effect on the accurate production of these affricates.

To the best knowledge of the researchers, there have not been any acoustic studies investigating the production of /tʃ/ and /dʒ/ among Libyan EFL University students. Therefore, the study attempts to answer the following questions:

- 1) How Libyan EFL learners produce the English affricates /tʃ/ and /dʒ/? What are the main types of substitutions that they use for both sounds?
- 2) Does the word position (word-initial, word-medial, and word-final positions) and the number of syllables within the word (monosyllabic, disyllabic and polysyllabic) will have any effect on the learners’ production of English affricates?

2 Literature review:

Many studies have discussed English pronunciation errors made by native speakers of different languages such as French, Japanese, Thai, Portuguese, etc. Many other studies have focused on studying pronunciation problems facing Arab speakers of different dialects like Saudi, Iraqi, Egyptian, Yemen, Sudanese as well as the Libyan Dialect. One of the major factors behind these problems is the different phonemic systems of Arabic and English. Other factors may include the influence of the mother tongue, differences in orthography, and the different levels of language proficiency (Othman 2021).

With regard to consonants, English has 24 consonants while Arabic has 28 consonants (Chouchane 2016). English consonants such as /p/ and /v/, for instance, are found in English but not in Arabic. (Abdulwhab, 2015). Even though some consonants may seem similar to some Arabic consonants like /t/ and /d/, for example, they are not exactly identical. They differ in their place of articulation. While /t/ and /d/ are alveolars in English; they are treated as dentals in Arabic (Al -Hattami 2010). Moreover, English /t/ is aspirated in word initial when followed by a stressed vowel as in [t^{hi}:] “tea”, whereas the Arabic /t/ is never aspirated in the same word position as in [ti:n] “fig” (Abdulwahab 2015).

The English affricates /tʃ/ and /dʒ/, which are the main focus of this study, have always been problematic for most Arab EFL learners (Elmahdi & Khan 2015, Bin-Hamza et.al 2020). As a result, both sounds undergo the process of “deaffrication” (Bin- Hamza & El-Weshahi 2018). In this process the voiceless affricate /tʃ/ is substituted with the voiceless fricatives /ʃ/, and the voiced affricate /dʒ/ is substituted with the voiced fricative /ʒ/, since both fricatives are common to Arab learners of English. The substitution is due to the absence of Affricates in most Arabic dialects, particularly the voiceless affricate /tʃ/, which is not found in the Arabic phonemic system such as MSA. The voiced affricate /dʒ/, on the other hand, may have different phonetic realizations in some Arabic dialects. Accordingly, most previous studies, as we shall see, have focused on the deaffrication of /tʃ/ rather than /dʒ/ (with the exception of Bin- Hamza et al. 2020 where the production of both affricates is considered, although it was not an acoustic study).

2.1 English Affricates:

English affricates, the voiceless /tʃ/ and the voiced /dʒ/, are "sounds produced with a constriction of complete closure followed by a release phase in which friction occurs" Philip (1999, 14). This means that affricates involve a complete closure as in the case of the stop and requires a friction as in the case of a fricative. O' Conner (1980, 47) provides a detailed characterization to the production of the English affricates. Both affricates are produced with the tip of the tongue touching the back part of the alveolar ridge, and the soft palate is raised so that the air is obstructed for a short period of time. Then, the tip of the tongue moves away slowly from the alveolar ridge, and the whole tongue is then moves in to the /ʃ, ʒ/ position and subsequently a short period of this friction is heard.

Roach (2000, 49) assumes that the stop /t/ and the fricative /ʃ/ which form the affricate /tʃ/ should be homorganic; i.e., sharing the same place of articulation. This can be justified by the fact that not every stop followed by a fricative can make up an affricate sound, as in the stop /k/ and the fricative /f/ in the word “breakfast”. /k/ and /f/ do not share the same place of articulation since /k/ is velar, while /f/ is labiodental. Thus, the homorganicity idea is to have both the stop and the fricative near to each other and this does not imply resemblance in place of articulation. However, researchers believe that there is still some contrast in place of articulation between the stop and the fricative which constitute the affricate. Mannell (2008), for example, believes that the stops /t/ and /d/ are alveolar, while the /ʃ/ and /ʒ/ are postalveolar. Wee & Winnie (2009) believe that homorganicity is to have the place of articulation of the stop and the fricative close to each other (cited in Abdely & Harden 2021, 38). This, however, relies on whether each of the affricates is treated as a single segment or as two separate segments.

There have been different debates on the phonemic status of affricates. In other words, it is not clear whether affricates should be defined as one phoneme or as two distinct phonemes (Roach 2010). The one- single phoneme analysis treats each of the pairs as a single consonant such as /tʃ, dʒ/ (Cruttenden 2001, Roach 2000); whereas the two-phoneme analysis is to say that each pair is composed of two independent phonemes, /t+ʃ/ and / d+ʒ/. According to Abdaly & Harden (2021, 37), the two-phoneme analysis is more economic. Language learners and even native speakers with no knowledge of phonetics have always felt that affricates consist of two different phonemes. This could be due to English spelling where the two consonants are represented sometimes by two letters. This to say that language users want to consider affricates are a combination of two phonemes i.e. consisting of two separate elements rather than two different single phonemes added to English’s phonemic inventory. In contrast, the single-phoneme analysis is based on various assumptions related to their allophonic variations and their distribution. Most of the assumptions are mentioned to support the single -phonemic analysis of affricates. These are summarized by Roach (2010, 97) who states that the phonemes /tʃ/ and /dʒ/ have a similar distribution to other English phonemes. These two phonemes can be found initially, medially, and finally as in “choose”, “juice”, “riches”, “ridges”, ”search” surge”. Secondly, the two affricates /tʃ/ and /dʒ/ may be combined with other consonants to form consonant clusters even though there are certain restrictions.

For instance, they cannot be part of initial clusters with other consonants and they are often followed by /t/ and /d/, and preceded by /l/ in final position */tʃ/ and */dʒ/. Finally, single-phoneme analysis assumes that the length of /ʃ/ and /ʒ/ in "hush" and "measure" are longer than the /ʃ/ within the phoneme /tʃ/ as in "hutch" and the phoneme /dʒ/ as in "jump". This phonetic argument has been tested and confirmed in an acoustic study conducted by Abdely and Harden (2021). The study concluded that the length of the fricatives /ʃ/ and /ʒ/ as separate phonemes differ from those in the affricates /tʃ/ and /dʒ/. The results of this study supports the complex-segment approach, which assumes that affricates share distinctive features with stops [-continuant] and with fricatives [+continuant] (Sagey 1986, Lombardi 1990, Clements 1990, Hall 2012, van de Weijer 1996, 2014). Thus, each pair of the affricates is treated as a single-phoneme and not as a combination of a stop+ fricative.

2.2 The status /tʃ/ and /dʒ/ in Arabic dialects:

Arabic dialects differ as to whether they include affricates as part of their phonemic systems. In MSA, *dʒ constitutes the only affricate sound (Monassar 2014, 62). Orthographically, the sound is represented as (ج). In Arabic dialects, the sound may be realized as [ʒ] or [dʒ] or both depending on which Arabic region one is talking about. For example, [ʒ] is found in many Levantine dialects, but [dʒ] may also be found in many Levantine rural dialects such as Iksal Arabic (Palestinian Variety)¹. Moreover, in many Arabic dialects, the pronunciation of /dʒ/ may range between /dʒ/, /g/, /ʒ/, and /j/.

For example, in Iraqi Arabic (more specifically Baghdadi Arabic), /dʒ/ may be pronounced as [dʒ], [ʒ], or [j]. In the Sultanate of Oman, on the other hand, the affricate /dʒ/ has three variants; /g/, /ʒ/, /j/. According to As-Sammer (2010), this variation in Omani dialect may be found not only within a specific region but it may vary depending on the position of the affricate within the syllable or the word. In San‘ani Arabic - and some parts of Kuwait as well as Bahrain, people use /dʒ/ as [dʒaw] ‘weather’. However, there are parts of Western Yemen where /dʒ/ is realized as [j]. In Cairene Arabic, /dʒ/ is pronounced as the reflex voiced velar [g], thus, /dʒaw/ ‘weather’ is pronounced as /gaw/. In Saidi, however, people use [dʒ] instead as in [dʒaw]. Finally, in many North African dialects, which range from Libya to

¹ Iksal Arabic is a Palestinian variety spoken in the village of Iksal (13,000 inhabitants) in the lower Galilee area of Israel.

Morocco, /dʒ/ in most cases is realized as /ʒ/. As a result, this variation has resulted in a complex overlap across Arabic dialect, since there is no clear clear-cut geographical or even dialectal boundary. According to Monassar (2014, 59), the affricate /dʒ/ has never been part of MSA’s phonemic system. Reviewing the phonemic or the even the orthographic systems Semitic languages Ugaritic, Assyrian, Aramaic, and Akkadian, they had neither /dʒ/ nor /ʒ/. As a result, this raises the question on how MSA come to have either or both of the respective phonemes /ʒ/ and /dʒ/.


Monassar (2014, 64) provides two assumptions with regard to this question. One assumption is that MSA acquired these sounds as a result of an external influence. In other words, Arabic came into contact with other languages such as Persian or Greek, and borrowed these sounds as a result. Perhaps, one of the variants i.e. /ʒ/ or /dʒ/ was borrowed and changed to be the other, while it remained unchanged in some Arab dialects. The second assumption comes from an internal influence reflected in sound change through phonological processes such as spirantization. Spirantization, also known weakening or lenition, is a process whereby a stop changes to a fricative, possibly forming affricates as an intermediary step in the process (Kenstowicks, 1994). Thus, in order to yield the MSA /ʒ/ or /dʒ/, the input must have had the semitic /g/ (Cantineau 1945, 56) (cited in Monassar, 2014). The fact that the semitic /g/ is the historical source for the MSA /ʒ/ or /dʒ/ comes from the definite article /ʔal-/ assimilation rule. According to the rule, the phoneme /l/ of the definite article assimilates to the next coronal phoneme. As a result, the Arabic alphabet has been divided into two sets: coronal and non-coronal consonants². The coronal consonants in Arabic are /ر r/, /ت t/, /ط tʰ/, /د d/, /ض ɖ/, /ز z/, /س s/, /ص ʃ/, /ش ʃʰ/, /ظ ɟ/, /ذ ɟʰ/, /ث θ/ /ن n/, /ل l/ which are known as the ‘the sun letters’. In contrast, the non-coronal consonants include: /ʔ ʔ/, /ب b/, /ج ʒ/dʒ/, /ح h/, /خ x/, /ع ʕ/, /غ ġ/, /ف f/, /ق q/, /ك k/, /م m/, /ي j/, /و w/, /ه h/. The two variants /ʒ/ and /dʒ/ are treated as non-coronal sounds in a relation to the definite article assimilation since assimilation does not apply in MSA e.g. /ʔalʒaamiʕa/, /ʔaldʒaamiʕa/ “the university”. The inapplicability of the assimilation rule to /dʒ/ or /ʒ/ because it retained some of the properties of the Semitic /g/ (Monassar 2014).

²Coronal sounds are articulated with the tip and/or blade of the tongue.

Accordingly, the Semitic /g/ has evolved to /ʒ/ through the process of “spirantization” which has transitioned through palatalization. Spirantization may have involved affricatization resulting in /dʒ/ as an intermediate stage. Accordingly, while some Arabic dialects have retained the Semitic phoneme /g/, some have come to have the intermediary phase /dʒ/, others have /ʒ/ as the final step of the sound change. Other Arabic dialects may have undergone one more step, i.e. spirantizing the Semitic /g/ to /j/, which already exists in their current phonemic inventory.

(1) The evolution of *dʒ (Monassar 2014,66)

g → gʸ → dʸ → j [dʒ] → ʒ [ʒ] (my brackets)



The voiceless affricate /tʃ/ is not present in MSA and in many Arabic dialects (Watson 2002, Monassar 2014). However, there are Arabic dialects which have a derived /tʃ/ (Mahajna & Davis 2016). Derived sequences of /t + ʃ/ are common in Arabic dialects that have the verbal negation marker /- ʃ/ as a suffix often over a morpheme boundary /ma-darasit-ʃ / ---> [madarasitʃ]) 'she did not study' or as a result of vowel syncope /bi-ti-ʃu:f / ---> [bitʃu:f] 'you see'. Based on a small survey and several arguments, Mahajna & Davis (2016, 13) claim that derived affricates are treated as a single segment if the examined dialect contains an affricate in its phonemic system e.g. San’ani Arabic has /dʒ/ in its sound system. On the other hand, Cairene lack the voiced affricate /dʒ/, thus, the derived /tʃ/ behaves as bisegmental i.e. combination of two segments (Mahajna & Davis 2016). Finally, it is suffice to say that the patterning of affricate in Arabic dialects require broader implications for phonological theory which goes beyond the objectives of this research.

2.3 Contrastive Analysis Hypothesis (CAH)

Contrastive Analysis Hypothesis (proposed initially by Fries in 1940 and developed by Lado in 1957) is widely used in Second Language Learning and Second Language Acquisition. The hypothesis states that contrasting two languages would help to predict or explain the elements that would cause difficulty or ease when learning another language. This can be achieved by realizing the differences and the similarities between the first language L1 and the second language L2 (Zaki 2015, 3). According to the hypothesis, elements in L2 that share similarity to L1 will be easier to master. However, different elements in both languages will

pose greater difficulty to learners. For example, there is no equivalent for the English affricate /tʃ/ in MSA. Thus, according to the hypothesis Arab learners may face difficulties when learning the sound. As a consequence, Arab learners reduce /tʃ/ to the fricative /ʃ/ in order to make it more similar to their L1 sound /ʃ/ or ش. This has been confirmed in Bin Hadjah & Jupri (2018), Bin -Hamza et.al (2020) for Yemeni EFL learners.

2.4 The language Transfer Theory (LTT)

According to the Language Transfer Theory (LTT) as put forward by Gass & Selinker (1994) (cited in Bin Hadjah & Jupri (2018, 106), the first language can affect the leaning of a second language either positively or negatively. Transfer will function positively whenever there are similar elements between the two languages. On the other hand, any difference between the two languages will lead to negative transfer. Gao (2005) claims that the L1 interference is one of the important factors that lead to producing errors in the process of learning English as a second language. This theory is essential to the study since it claims that EFL learners may not produce, for instance, the English affricate /tʃ/ because of the interference (i.e. negative transfer) of the learners' L1. L1 interference would be shown if the learners produced the [ʃ] sound instead of producing /tʃ/ because the English /ʃ/ sound is quite similar to the Arabic /ʃ/ or ش. This has been revealed in Bin Hadjah & Jupri (2018) and Bin Hamza & Al-Weshahi (2018). Another type of L1 interference has been shown in the study of Bin-Hamza et.al (2020) where Yemeni learners produced [j] instead of /dʒ/ since in some varieties of Yemeni Arabic, the Arabic (ج) is produced in a way similar to that of the English /j/.

2.5 Markedness Differential Hypothesis (MDH)

Markedness Differential Hypothesis (MDH) was proposed by Eckman (1977, 271) as a revision of the Contrastive Analysis Hypothesis. The theory predicts that if language A has a marked structure which is unmarked or less marked in language B, the speakers of language B should learn the marked structure in language A. To put it in simple words, marked and uncommon structures between languages are harder to master than those that are less marked and more common. Thus, according to the hypothesis Arab EFL learners will find it hard to learn the English post- alveolar affricates /tʃ/ and /dʒ/ because they are considered more

marked than the fricatives /ʃ/ and /ʒ/. This is with the exception of few Arabic dialects which include quite similar phonemic or allophonic realizations to the English affricate /tʃ/ and /dʒ/.

2.6 Previous studies (Deaffrication in Arabic dialects):

Several studies have shown that Arab learners of English have problems in pronouncing the English affricates. For instance, Jabali & Abuzaid (2017) have examined the pronunciation errors made by Palestinian students at An-Najah University. The results of the study have shown that the most problematic sounds were /p/, /tʃ/, /dʒ/, /ɪ/, and /ŋ/. With respect to the affricate sounds, both authors have found that Palestinian learners replaced /tʃ/ with [ʃ] in all word positions. The reason behind this is that /tʃ/ is not found in the phonemic system of the Palestinian dialect. The affricate /dʒ/ was also problematic because the Palestinian students either used [dʒ] for both /dʒ/ and /ʒ/, or they used [ʒ] for both sounds. In other words, both the affricate and the fricative were used interchangeably. Thus, English words such as “strange” and “garage” may be pronounced either as /streɪndʒ/ and /gərədʒ/ or as /streɪnʒ/ and /gərəʒ/.

Bin- Hamza & El-Weshahi (2018) conducted a phonetic study on the deaffrication of the affricate /tʃ/ by Arab learners. The results of the study have revealed that the deaffrication of /tʃ/ had occurred in all positions. Their results support the Language Transfer Theory (LTT) by Gass & Selinker 1983, since the phoneme /tʃ/ is deaffricated into the phoneme [ʃ]. Furthermore, the findings also support the claims of the Markedness Differential Hypothesis (MDH) by (Eckman 1977). Since the /tʃ/ is more marked than /ʃ/; the speakers have substituted /tʃ/ with [ʃ], respectively.

Bin Hadjah & Jupri (2018) conducted a study to investigate the production of the affricate /tʃ/ by Yemeni EFL learners by using Praat phonetic software. The study has shown that Yemeni speakers have substituted /tʃ/ with [ʃ] in initial and mid positions but in some words in final position. The results of the study are also in the line with the Markedness Differential Theory (MDT) since /tʃ/ is considered a marked sound in Yemeni dialect. It also supports the claims of the Contrastive Analysis Hypothesis (CAH) and the Language Transfer Theory (LTT). Following the assumption of CAH, the Yemeni dialect has no equivalent to English /tʃ/. Thus, learners have deaffricated /tʃ/ into [ʃ] which is more similar to their L1 /ʃ/. Moreover,

the lack of /tʃ/ has led to negative language transfer which occurs whenever there is a difference between L1 and L2.

In Bin -Hamza et.al (2020), the study has focused on the deaffrication of /tʃ/ and /dʒ/. Based on the observation of two Yemeni speakers, it was shown that the speakers deaffricated /tʃ/ to [ʃ] in all positions especially in word- final. In the line with the studies of Bin Hamza & Al-Weshahi (2018) and Bin Hadjah & Jupri (2018), this substitution supports both LTT and MDH theories. However, the study uncovered that the production of /dʒ/ was challenging and different realizations have been shown in the speech of both speakers. The deaffrication of /dʒ/ to [ʒ] was found in some words in the production of both speakers. However, one speaker palatalized /dʒ/ to [j]. This could be due to the fact that in some areas of Yemen, the Arabic (ج) may be pronounced in a way similar to /j/. This substitution supports the LTT which assumes that, if a learner's first language L1 and the target language L2 are similar; the first language will aid the foreign language learning (Bin- Hamza et.al 2020). In other words, similarities between the L1 and L2 facilitate the learning process.

3 Methodology:

The current study is a quantitative acoustic investigation which aims to explore the process of deaffrication among Libyan university students. The study aims to investigate how Libyan students (in the pre-sessional semester at the Department of English / Faculty of Language - University of Tripoli) pronounce English affricates, whether or not there is a relationship between the position of the affricate, the number of syllables within the target words and the process of deaffrication of /tʃ/ and /dʒ/.

3.1 The Participants

Eight native speakers of the LD (4 males and 4 females) who were at the time of the study pre-sessional students at the Department of English, Faculty of Languages –University of Tripoli, took part in this study. Their age range at the time of data collection was 18-22. The Participants read the information sheet about the study and signed a consent form about their participation before the recording session. The participants were individually recorded in a quiet and comfortable room by using a Toshiba Laptop and a logitech microphone. The

participants were allowed to read the sentences with the target words before recording. During the rest of the paper, the participants will be referred to as speaker 1, speaker 2... etc.

3.2 The Material:

As can be seen in the table (1) below, the wordlist has fifty-two words (26 words for /tʃ/ and 26 for /dʒ/) arranged in 8 contexts as follows: 8 monosyllabic words with the affricate in initial and final position (4 words in each word position - context 1 and 2). There were 12 disyllabic words with the affricate in initial, middle and final position (4 words in each word position – context 3, 4 and 5). Finally, there were 6 polysyllabic words with the affricate in initial, middle and final position (2 words in each word position – context 6, 7 and 8).

Table (1) the 8 contexts of /tʃ/ and /dʒ/ which were investigated in this study

context	words
Context 1	4 monosyllabic words with /tʃ/ and /dʒ/ in initial position (4 words each)
Context 2	4 monosyllabic words with /tʃ/ and /dʒ/ in final position (4 words each)
Context 3	4 disyllabic words with /tʃ/ and /dʒ/ in initial position (4 words each)
Context 4	4 disyllabic words with /tʃ/ and /dʒ/ in medial position (4 words each)
Context 5	4 disyllabic words with /tʃ/ and /dʒ/ in final position (4 words each)
Context 6	2 polysyllabic words with /tʃ/ and /dʒ/ in initial position (2 words each)
Context 7	2 polysyllabic words with /tʃ/ and /dʒ/ in medial position (2 words each)
Context 8	2 polysyllabic words with /tʃ/ and /dʒ/ in final position (2 words each)

3.3 Data Analysis:

The recorded data was evaluated by two main methods. Firstly by listening to the target words to determine whether or not the target words were accurately produced by the eight speakers, and then by visual inspection of the spectrograms and waveforms of the recording using Praat software. A three-likert scale was adopted to evaluate the productions. The scale included 1- correct pronunciation of the affricate, 2- wrong pronunciation of the affricate (deaffrication) and 3- wrong pronunciation of the whole word. Wrong pronunciations were marked as missing data, and hence excluded from the analysis

3.4 Results of the influence of the environment on the production of /tʃ/ and /dʒ/

In general, the percentage of accurate productions of /tʃ/ as produced by the eight speakers is 73.4%. The percentage of accurate productions of /dʒ/ is 52.3%. Results of the productions of /tʃ/ and /dʒ/ in each context are shown in table (2).

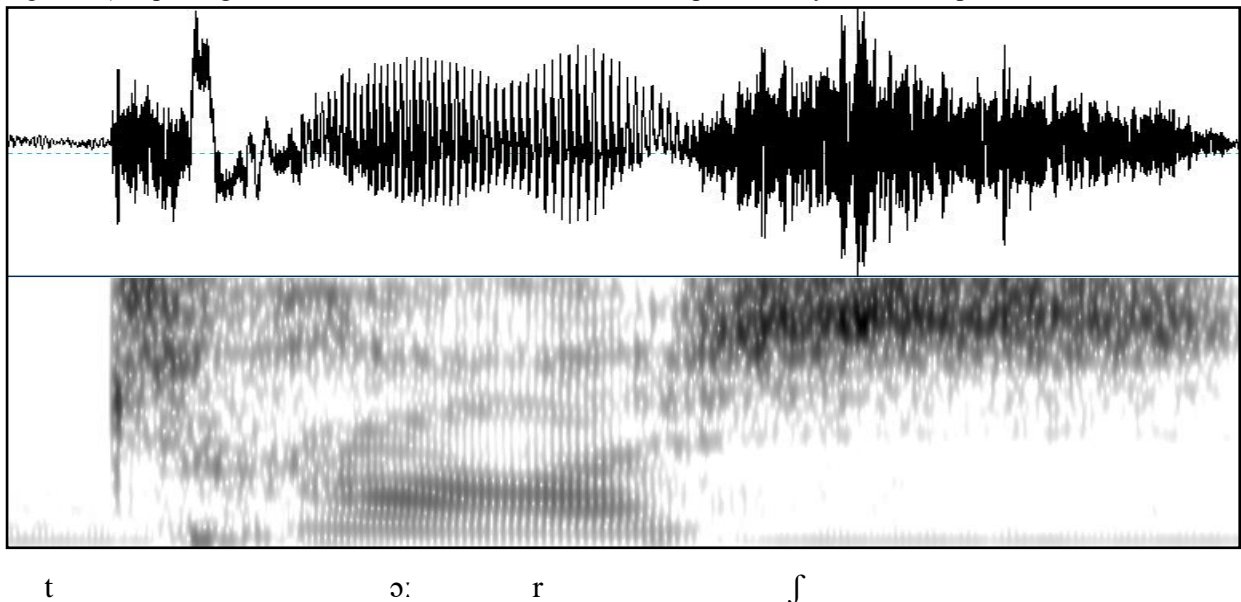
Table (2) the productions of /tʃ/ and /dʒ/ in each context by all speakers.

target sound	Context	1	2	3	4	5	6	7	8
	pronunciation								
/tʃ/	Affricated	84.3%	43.7%	90.6%	74.9%	68.7%	81.2%	56.2%	87.5%
	Deaffricated	15.7%	56.3%	9.4%	25.1%	31.3%	18.8%	43.8%	12.5%
/dʒ/	Affricated	71.8%	43.7%	78.1%	50%	50%	56.2%	25%	43.7%
	Deaffricated	28.2%	56.3%	21.9%	50%	50%	43.8%	75%	56.3%

- /tʃ/ and /dʒ/ in monosyllabic words (initial and final positions)

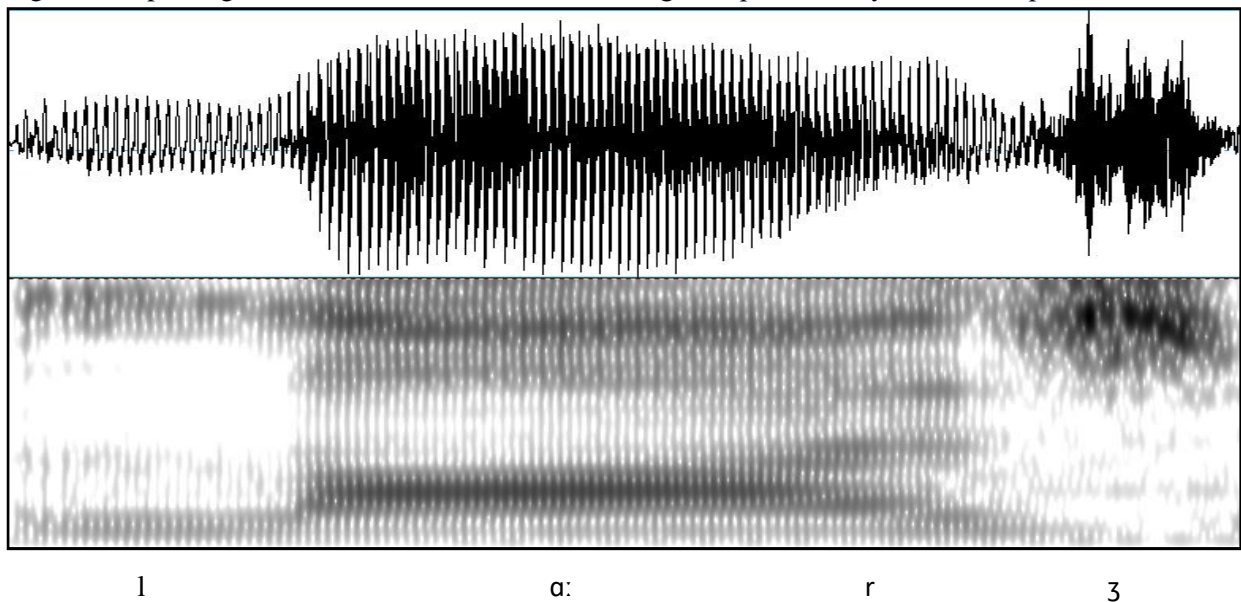
In monosyllabic words, when /tʃ/ was in word initial position, it was deaffricated in 15.7% of all the tokens. In the same context, /dʒ/ was deaffricated in 28.2% of all the tokens. When /tʃ/ was in final position, the number of inaccurate productions as a result of deaffrication was 56.3%. Figure (1) shows the production of the word “torch” by one of the speakers. As can be seen from the spectrogram, the post-alveolar affricate /tʃ/ is deaffricated and the word is produced as /tɔ:rʃ/ instead of /tɔ:rtʃ/

Figure (1) Spectrogram and waveform for the word “torch” as produced by one of the speakers.



In final position, the speakers produced /dʒ/ as /ʒ/ in 43.7% of all the words too. An example of the deaffrication of /dʒ/ in final position can be seen in figure (2). Here, the /dʒ/ is deaffricated and the word “large” is produced as /lɑ:ʒ/ instead of /lɑ:dʒ/

Figure (2) Spectrogram and waveform for the word “large” as produced by one of the speakers

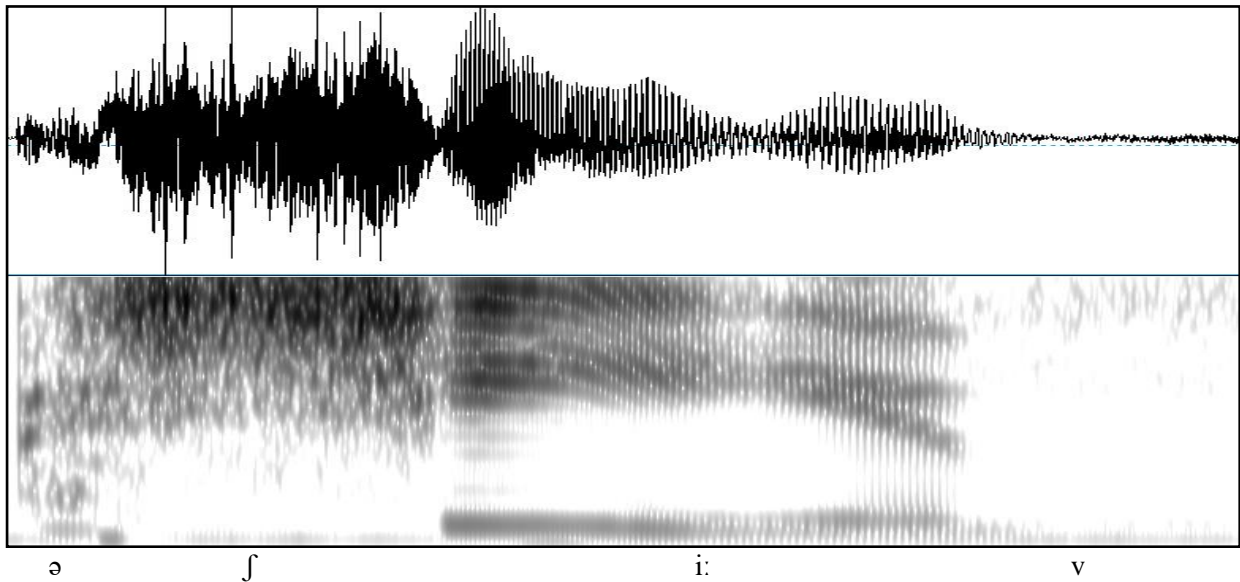


Participants chose not to affricate when they produced the word “French” and 7 out of 8 participants produced the word “branch” without /tʃ/. It is obvious that most participants opted to deaffricate the /dʒ/ in final position in words such as “orange”, “merge” and “large”.

- **/tʃ/ and /dʒ/ in disyllabic words (initial, medial and final positions)**

In disyllabic words when /tʃ/ was in initial position, it was deaffricated in 9.4% of all the tokens. In the same context, the percentage of inaccurate pronunciations of /dʒ/ as a result of deaffrication was 21.9%. In middle position, /tʃ/ was pronounced as /ʃ/ in 25.1% of all the tokens, while /dʒ/ was deaffricated in 50% of the target words. The spectrogram in figure (3) shows how /dʒ/ was deaffricated in the word “achieve” which was produced as /ə'ʃi:v/ instead of /ə'tʃi:v/.

Figure (3) Spectrogram and waveform for the word “achieve” as produced by one of the speakers.



In final position, deaffrication of /tʃ/ took place in 31.3% of all the target words; the percentage of /dʒ/ being deaffricated has increased to 50%.

- **/tʃ/ and /dʒ/ in polysyllabic words (initial, medial and final positions)**

In polysyllabic words when /tʃ/ was in initial position, it was deaffricated in 18.6% of all the tokens, while for /dʒ/ in the same context; the percentage has increased to 43.8%. In middle position, /tʃ/ was substituted with /ʃ/ in 43.8% of all the tokens, and /dʒ/ was deaffricated in 75% of all the target words. In final position, deaffrication of /tʃ/ was observed in 12.5% of all the target words, and /dʒ/ was produced as /ʒ/ in 56.3% of all the target words in this context.

3.5 Inter and intra-speaker variability:

The percentage of accurate production of /tʃ/ and /dʒ/ per speaker is shown in table (3).

Table (3) The percentage of accurate productions per speaker:

target sound	Participant pronunciation	FP1	FP2	FP3	FP4	MP1	MP2	MP3	MP4
/tʃ/	Affricated	59.3%	84.3%	84.3%	87.5%	43.7%	81.2%	84.3%	62.5%
	Deaffricated	40.7%	15.7%	15.7%	12.5%	56.3%	18.8%	15.7%	37.5%
/dʒ/	Affricated	28.1%	59.3%	78.1%	34.3%	31.2%	93.7%	56.2%	37.5%
	Deaffricated	71.9%	40.7%	21.9%	65.7%	68.8%	6.3%	43.8%	62.5%

Speaker 1:

In the productions of this speaker, deaffrication of /tʃ/ in all contexts took place in 40.7% of the tokens. She produced /tʃ/ as /ʃ/ in 75% of monosyllabic words (initial and final position). In disyllabic words, she deaffricated the /tʃ/ in final position in words like “approach” and “Greenwich”. She did not seem to have any difficulty producing /tʃ/ in polysyllabic words. Deaffrication of /dʒ/ in all contexts took place in 71.9% of the tokens. This participant faced some difficulties producing /dʒ/ in monosyllabic words, especially in final position. She even had more difficulty with /dʒ/ in disyllabic and polysyllabic words in words like “jellyfish”, “Japanese”, “college” and “villages”.

Speaker 2:

This participant did not seem to have much difficulty producing /tʃ/, as deaffrication of /tʃ/ in all contexts took place in 15.7% of the tokens. Disyllabic words, apart from the words “research” and “dispatch”, were also produced without deaffrication. However, in polysyllabic words, the process of deaffrication was adopted more frequently. Deaffrication of /dʒ/ on the other hand took place in 40.7% of the tokens. There were many examples where /dʒ/ was produced as /ʒ/. Such words include “merge” and “large”. In addition, the same difficulty was observed in disyllabic words (final position) and in polysyllabic words (initial position and final position).

Speaker 3:

The overall percentage of /tʃ/ deaffrication was 15.7% of all the tokens. This participant produced /tʃ/ as /ʃ/ in monosyllabic words in initial position only. Deaffrication was applied more in disyllabic and polysyllabic words in all positions. When producing words containing /dʒ/, the participant did not seem to have difficulty producing them, especially monosyllabic words. The percentage of producing /dʒ/ as /ʒ/ was 21.9% of all the tokens. Despite this

relatively low percentage, there were some instances of deaffrication of /dʒ/ in disyllabic and polysyllabic words.

Speaker 4:

The percentage of inaccurate productions of /tʃ/ as a result of deaffrication was 12.5%. This participant applied deaffrication of /tʃ/ in monosyllabic words, final positions, in words like “pitch” and “branch”. More difficulty was observed in disyllabic and polysyllabic words where /tʃ/ was in initial, middle and final position. Deaffrication of /dʒ/ was applied in initial position in disyllabic words. The percentage of /dʒ/ deaffrication was 65.7%. The words which the participant did not affricate are “Germany”, “Japanese”, “college” and “Jellyfish”. This could be the result of word frequency.

Speaker 5:

Deaffrication of /tʃ/ took place in 56.3% of all the tokens. In monosyllabic words, this participant did not have any difficulty in producing /tʃ/ in initial position. In final position, however, deaffrication was applied in words such as “pitch” and “branch”. Deaffrication was applied more often in disyllabic and polysyllabic in words such as “dispatch” and “eventually”. The process of deaffrication was more evident in all of the words containing /dʒ/. Deaffrication of /dʒ/ took place in 68.8% of all the tokens. This means that this participant produced /dʒ/ as /ʒ/ in most of the target words, especially in disyllabic and polysyllabic words.

Speaker 6:

The overall percentage of producing /tʃ/ as /ʃ/ was 18.8%. This speaker produced /tʃ/ as /ʃ/ in some monosyllabic in words such as “branch”. Deaffrication has been more frequent in disyllabic and polysyllabic words such as “challenges”, “century”, “chesterfield” and “eventually”. On the other hand, deaffrication of /dʒ/ took place in 6.3% of all the tokens. /dʒ/ was deaffricated in only disyllabic words such “orange”. This participant had only some difficulty producing the affricate /dʒ/ in the rest of disyllabic and polysyllabic words.

Speaker 7:

For this speaker, deaffrication of /tʃ/ took place in 15.7% of all the tokens. He deaffricated final /tʃ/ in monosyllabic words such as “French” and “branch”. In disyllabic and polysyllabic,

more deaffrication has been observed, especially in initial and middle position. This speaker produced /dʒ/ as /ʒ/ in 43.8% of all the target words, especially in final position in monosyllabic words. Deaffrication was applied more in disyllabic words in words such as “object” and “legend”, and in final position of disyllabic words such as “damage” and “college”. In polysyllabic words, deaffrication has been highly seen in words such as “privilege” and “management”.

Speaker 8:

The overall percentage of deaffrication of /tʃ/ by the last speaker was 37.5%. He did not have much difficulty with /tʃ/ in monosyllabic and in initial position in disyllabic words. However, there was some difficulty with /tʃ/ in middle position in words such as “purchase” and “culture”. This speaker produced /tʃ/ in initial position in polysyllabic words such as “Chesterfield” and in middle position in “century” and “eventually”. As for the production of /dʒ/, it was deaffricated in 62.5% of the tokens. Deaffrication of /dʒ/ took place in monosyllabic words such as “large”, and in disyllabic words such as “object”, “imagine”, “damage” and “average” and in almost all of polysyllabic words.

Although the influence of gender on the production of English affricates was not one of the aims of this study, it was noticed that female participants produced more accurate pronunciations of /tʃ/ in all positions (78.9% compared to 67.9% which is the male participants’ accurate pronunciations of /tʃ/). As for /dʒ/, male participants produced more accurate pronunciations (54.6% compared to 50% which is the number of accurate pronunciations of /dʒ/ as produced by the female group).

4 Discussion of the results:

According to the data presented above, the process of deaffrication was adopted by all participants at some point. In monosyllabic words, it was obvious that the speakers had more difficulty producing initial /dʒ/. The percentage of accurate pronunciations of /tʃ/ was 84.3%, compared to 71.8% for /dʒ/. In the same context, monosyllabic words, but in final position, it seems that the participants had the same difficulty as the percentage of accurate pronunciation for both affricates decreased to 47.8%. In this context, Participants chose not to affricate when

they produced the word “French” and 7 out of 8 participants produced the word “branch” without /tʃ/. It was also obvious that most participants opted to deaffricate the /dʒ/ in final position in words with high frequency such as “orange”, “merge” and “large”. These results support the findings of previous studies (e.g. Jabali & Abuzaid 2017, Bin -Hamza et.al 2020), where /tʃ/ and /dʒ/ were substituted with /ʃ/ and /ʒ/.

In disyllabic words, and in all word positions, it seems that all speakers had more difficulty producing /dʒ/. The percentage of accurate pronunciations in word initial was 90.6% for /tʃ/, compared to 78.1% for /dʒ/. In word-medial position, the speakers did not substitute /tʃ/ for /ʃ/ in 74.9% of the target words, compared to 50% where /dʒ/ was substituted by /ʒ/. In final position of disyllabic words, the percentage of accurate productions of /tʃ/ was 68.7% compared to 50% for /dʒ/. In all word positions within polysyllabic words, and like in disyllabic words, all speakers had the same difficulty producing /dʒ/. The percentage of accurate pronunciations in word initial was 81.2% for /tʃ/, compared to 56.2% for /dʒ/, in word-medial position 56.2% accurate productions for /tʃ/ compared to 25% for /dʒ/, and in word-final position 87.5% accurate productions for /tʃ/ compared to 43.7% for /dʒ/.

The results provide strong support to Contrastive Analysis Hypothesis (Fries, 1940 and Lado, 1957), and The Language Transfer Theory (Gass & Selinker (1994) in that L2 learners transfer the knowledge they had acquired during the process of learning their L1, and this transfer of knowledge can negatively affect acquisition when the two languages are not similar. The results are also in agreement with the claims put forward by Markedness Differential Hypothesis (Eckman (1977) where marked L2 features are more difficult to master than unmarked ones.

In monosyllabic, the position of /tʃ/ within the word seems to have an influence on accuracy. The number of instances where /tʃ/ was deaffricated increased 15.7% in initial position compared to 56.3% in final position. These results are in line with the findings of Bin-Hamza & El-Weshahi (2018) and Bin Hadjah & Jupri (2018) who have investigated the production of /tʃ/ and concluded that it was common to substitute /tʃ/ with /ʃ/ in the speech of Yemeni learners of English.

The same is true in disyllabic words; i.e. there were more instances of deaffrication as the position of /tʃ/ within the word moved from initial to final position. In polysyllabic words, the position of /tʃ/ within the word seemed to have an effect on accuracy, as the percentage of inaccurate productions increased from 18.8% in initial position to 43.8 in middle position. In final position in the same context there was actually an increase in the accurate productions of /tʃ/, which means that the speakers did not deaffricate the /tʃ/.

As for /dʒ/ in monosyllabic, its position within the word seems to have an influence on accuracy. The number of instances where it was deaffricated increased from 28.2% in initial position to 56.3% in final position. In disyllabic words, there were more instances of deaffrication as the position of /dʒ/ within the word moved from initial to final position (21.9% in word-initial position to 50% in word-final position). The same can be observed in polysyllabic words, as the percentage of inaccurate productions increased from 43.8% in initial position to 75% in middle position. However, in final position, the number of inaccurate productions of /dʒ/ decreased to 56.3%.

5 Conclusion:

This study has focused on the production of English postalveolar affricates by Libyan university students. Specifically, it aimed at investigating how Libyan university students would pronounce English /tʃ/ and /dʒ/ in different positions within the word, and whether their position within the word (initial, medial and final) and the number of syllables of the target word would affect the accuracy of the production of these affricates. The results showed that Libyan learners of English have major difficulties in producing English affricates /tʃ/ and /dʒ/. Most of the participants struggled to produce words with /tʃ/ and /dʒ/ correctly. Since these affricates have no equivalent in the Libyan learners L1, they resorted to the process of “deaffrication” when they encountered these sounds, especially with /dʒ/ which was more difficult to produce than /tʃ/.

Despite the fact that the results were mixed; there was a relationship between the position of the affricate, the number of syllables within the word and the process of deaffrication. The results have shown that deaffrication was more frequent as the number of syllables increased.

This was the case with the production of disyllabic words and polysyllabic words, but not with final position of monosyllabic. The position of the affricate moved from initial to middle position. However, deaffrication of /tʃ/ and /dʒ/ in word-final position for both disyllabic and polysyllabic words was less frequent in comparison with middle position.

The process of deaffrication was seen more in /dʒ/. There were also some gender differences in the application of the process of deaffrication. The claims of “Language Transfer Theory” “Contrastive Analysis Hypothesis” and the “Markedness Differential Hypothesis” have been to some extent confirmed. However, in order to be able to generalize the findings of this study, more data and more studies are needed.

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Appendix

Word list for /tʃ/

Monosyllabic words

	/tʃ/ in word-initial position	/tʃ/ in word-initial position
1-	chew	pitch
2-	cheap	French
3-	church	torch
4-	chop	branch

Disyllabic words

	/tʃ/ in word-initial position	/tʃ/ in word-middle position	/tʃ/ in word-final position
1-	charity	purchase	approach
2-	cheddar	culture	research
3-	chopstick	achieve	dispatch
4-	chapel	picture	Greenwich

Polysyllabic words

	/tʃ/ in word-initial position	/tʃ/ in word-middle position	/tʃ/ in word-final position
1-	challenges	century	butterscotch
2-	Chesterfield	eventually	microswitch

Word list for /dʒ/

Monosyllabic words

	/dʒ/ in word-initial position	/dʒ/ in word-initial position
1-	just	badge
2-	joy	cage
3-	giant	merge
4-	juice	large

Disyllabic words

	/dʒ/ in word-initial position	/dʒ/ in word-middle position	/dʒ/ in word-final position
1-	jacket	object	damage
2-	gentle	region	college
3-	jellyfish	legend	average
4-	German	engine	language

Polysyllabic words

	/dʒ/ in word-initial position	/dʒ/ in word-middle position	/dʒ/ in word-final position
1-	Japanese	villages	privilege
2-	journalist	management	advantage