



Burns, Roslyn. 2022. Mechanisms of sub-phonemic change in prescriptive bilingualism: The case of Mexican Plautdietsch. *Glossa: a journal of general linguistics* 7(1), pp. 1–36. DOI: <https://doi.org/10.16995/glossa.5744>



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## Mechanisms of sub-phonemic change in prescriptive bilingualism: The case of Mexican Plautdietsch

Roslyn Burns, Yale University, US, [roslyn.burns@yale.edu](mailto:roslyn.burns@yale.edu)

This paper investigates the relationship between loanword adaptation and phonological borrowing by looking at an enclave of the Mexican Plautdietsch speech community in Texas. Plautdietsch (ISO 639-3, pdt) borrowings from Mexican Spanish sometimes undergo loanword adaptation to fit the native phonological system (e.g. Spanish [peso] *peso* ‘peso’ > Plautdietsch [pæzo]), but some community members exhibit a pattern of deaffrication that targets native lexical items (e.g. [diʧ] ‘German’ > [diʃ]). I suggest that the output of /ʧ/ deaffrication in Mexican Plautdietsch follows a pattern of deaffrication closer to that of regional Mexican Spanishes, rather than an inherited pattern that historically adapted loanwords from High German and Russian. I propose that while some mechanisms of phonetic and phonological interpretation are similar for both loanword adaptation and phonological borrowing, the novel Mexican Spanish pattern could have only entered the community due to the unique structure of phonological representation associated with advanced bilingualism. This prediction is borne out in the social distribution of deaffrication wherein men, who are expected to become advanced bilinguals, exhibit the innovation more than women. By adding a dimension of phonological representation to our models of loanword adaptation, we can expand the model’s behavior to also account for outcomes involving the restructuring of heritage languages.

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## 1 Introduction

The effects of loan phonology are often divided into innovations which restructure the contact language and innovations which restructure the heritage language. This paper explores relationship between the mechanisms underlying these two contact effects by analyzing borrowings in Plautdietsch (West Germanic, ISO 639-3, pdt) from Mexican Spanish. Plautdietsch, the heritage language of Netherlandic Mennonites, first came into contact with Mexican Spanish in the 1920's. To date, Plautdietsch literature across different regional communities only identifies non-phonological borrowings (Thiessen 1963; Nieuweboer 1998; Kaufmann 2007; 2011; 2015; Siemens 2012). Burns (2016a) provides evidence that Mexican Plautdietsch has borrowed words from Mexican Spanish (e.g. Spanish [peso] *peso* 'peso' > Plautdietsch [pəɪzo]) but borrowed lexical items are often restructured to fit the native Plautdietsch phonological system. When the phonological characteristics of a word in a contact language are altered to fit within the native language's phonological structure, it is called *loanword adaptation*. In this paper, I propose that a different, but related phonological process has occurred in Mexican Plautdietsch, borrowing of the phonological innovation /tʃ/ > [ʃ] (e.g. Spanish [muˈtʃo] *mucho* 'much' > [muʃo]) from regional Mexican Spanish. Reflexes of this innovation, known as *deaffrication*, appear in Plautdietsch in both loanwords from Mexican Spanish and some native words (e.g. Plautdietsch [dɪtʃ] 'German' > [diʃ]). Many Plautdietsch enclaves in North America are descendant from the Mexican Plautdietsch community (Burns 2021), and English spoken in Mexican Plautdietsch enclaves in the US, which are the focus of this study, sometimes exhibits this feature as in [lʌntʃ] > [lʌnʃ] *lunch*.

While phonological transfer literature analyzes how categorical L1 phonemic mapping relationships are established from gradient L2 phonetic inputs (Kenstowicz & Suchato 2006; Peperkamp et al. 2008; Kang 2010; de Jong & Cho 2012), some studies show that even with established categorical mappings, L1 language phonemes can be subject to subtle gradient sub-phonemic changes based on the phonetic input from the contact language (Sancier & Fowler 1997; Babel 2009; Chang 2012).

I establish that a Mexican Plautdietsch enclave in Texas exhibits gradient linguistic differences in the realization of affricates which are rooted in prescriptive social attitudes towards bilingualism. Community members who are expected to become proficient bilinguals are the first to adopt the innovation, men who learned Spanish in traditional communities, but community members who are expected to have low bilingual competence resist the innovation, women from traditional communities. As time passes, younger generations begin to accept deaffricated forms as just a part of the language unless their competence shifts towards a contact variety that does not support deaffrication (i.e. the adoption of an English-based model by younger men).

The findings of this social pattern force us to reconcile whether the two phonological interference effects in Plautdietsch (loan phonology adaptation and restructuring of the heritage language's phonological system) owe themselves to distinct underlying mechanisms, or whether

the two different outcomes of phonological transfer are in some way related and share a single underlying mechanism. It is most parsimonious if we assume that loanword adaptation and other forms of phonological transfer share a core set of underlying mechanisms, but observed differences in the outcome of loan phonology owe themselves to a separate factor: variability of each language's structural representation. By incorporating the factor of structural representation, the current models of loanword adaptation can be expanded to account for the effects of traditional loanword adaptation as well as gradient restructuring of the heritage language.

The rest of section 1 establishes the framework for understanding phonological transfer. I propose a model in which an L2 can influence the structure of an L1, thus triggering sub-phonemic changes. Section 2 gives background to the Mexican Plautdietsch community and its enclaves. Section 2.1 provides the socio-historical background of the Mexican Plautdietsch community. Gender roles commonly dictate interactions with outsiders in traditional settlements, but some daughter settlements, including the one in the US where data were collected, have rejected this social structure. Section 2.2 presents the consonant inventories in contact. Notably Plautdietsch / $\widehat{tj}$ / exists as a weakly supported phoneme (i.e. having low functional load and notable phonotactic restrictions), but in English and Spanish, the phoneme is more robust.

Section 3 presents the phonetic and community-specific patterns of deaffrication. Historically, deaffrication in Plautdietsch targeted non-native affricates like High German [ $\widehat{ts}$ ] and Russian [ $\widehat{tɕ}$ ]. Many studies treat deaffrication as categorical, but studies of Mexican Spanish / $\widehat{tj}$ / deaffrication indicate that the process exists along a continuum. The phonological distribution of historical Plautdietsch deaffrication differs from that of Mexican Spanish / $\widehat{tj}$ / deaffrication. In order to qualify as a contact-based innovation, [ $\widehat{tj}$ ] deaffrication should exhibit a pattern which is more than just an extension of the historical process in Plautdietsch and the social properties of the Plautdietsch speech community must align with known social traits of the innovation in Mexican Spanish.

Section 4 presents the methodology for investigating deaffrication in a Mexican Plautdietsch enclave in Texas. This survey involved thirteen consultants of different ages, genders, and regional affiliations. Section 5 presents the findings of this study which implicate older men from Mexico as the leaders of [ $\widehat{tj}$ ] deaffrication whereas older women from Mexico resist the innovation. While younger women have begun to adopt the innovation, broader uptake is hindered in younger generations by the shift to American English. This shows that bilingual representation is important in two ways. First, the innovation entered the heritage language through men who were competent in a deaffricating L2, but when younger generations shifted towards competence in an L2 with non-alternating affricates, such as English, the innovation begins to recede. Finally, section 6 closes with the implications of this study by revisiting the link between the mechanisms underlying loanword adaptation and subtle sub-phonemic changes in the heritage language.

## 1.1 Theoretical assumptions

Language contact theory analyzes phonological transfer in terms of either *when* or *how* innovation occurs. Theories which explain *when* phonological transfer occurs are best typified by Thomason & Kaufman (1988) and Van Coetsem (1988). Thomason & Kaufman (1988) rely on social factors to predict when transfer is likely to occur whereas Van Coetsem relies on psychological factors in the so-called *linguistic agentivity model*.<sup>1</sup> In this model, when individuals who are dominant in one language imperfectly learn another, the dominant language structures are superimposed on the L2 thereby restructuring the L2 (called *Source Language/SL Agentivity*). When individuals who are linguistically dominant in one language have a weakly supported phonological structure, they may rely on a less dominant language with clearer usage patterns to help support the otherwise weak structure in the dominant language (called *Recipient Language/RL Agentivity*).

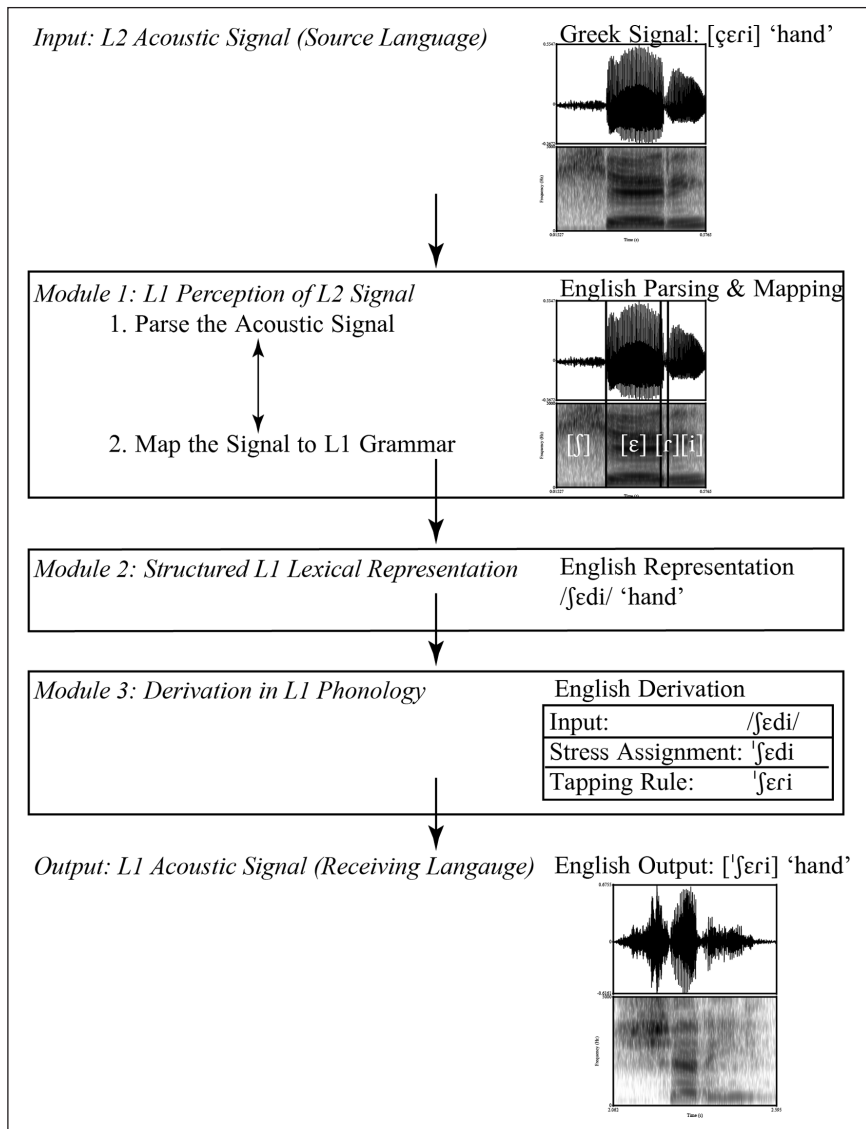
Accounts of *how* phonological transfer happens focus on the mechanism of mapping structures between languages. Most of these accounts are of loanword adaptation and consequently focus on SL agentivity. These approaches assume three discrete modules: perception, structured representation, and production (Peperkamp et al. 2008; Boersma & Hamann 2009; Kim 2009). First, an acoustic signal from an L2 is chunked and mapped onto the L1's sound system. The mapped chunks are then bundled into a lexical unit and stored in the mental lexicon. Finally, the speaker may access that stored lexical item and filter it through their native phonological system thereby producing an acoustic signal whose output is restructured. **Figure 1** schematizes a Greek word passing through the author's L1 English grammar based on Kim's (2009: 158) representation.

This approach offers a sophisticated explanation of *how* phonological interference occurs, but it (a) assumes categorical relations and (b) can only account for an L1 restructuring signals from a non-native system. To the first point, loan phonology can have gradient sub-phonemic outputs (Sancier & Fowler 1997; Guion 2003; Babel 2009; Chang 2012). This effect is known as *gestural drift* (Sancier & Fowler 1997). To the second point, contact literature has observed a number of cases where the adopted language of a speech community restructures the heritage language (e.g. Chirkova & Gong 2019). A truly explanatory model of phonological interference needs to be able to account for interference in either direction.

Guion's (2003) investigation of Spanish-Quichua bilingual vowel systems shows that specific types of bilinguals can restructure contact languages differently. The high vowels /i/ and /u/ in Quichua's 3-vowel system are acoustically not as peripheral as the high vowels in the Spanish 5-vowel system (Guion 2003: 104). The phonetic and phonological outcomes of language contact depend on whether the speaker is a *simultaneous bilingual*, someone who developed linguistic competence in both languages at once, or a *successive bilingual*, someone who developed

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<sup>1</sup> Van Coetsem's term *linguistic agentivity* should not be confused with a volitional act on behalf of speakers. Although some approaches to change in progress rely on intentional use of variation for social purposes, this is not the focus of this paper, nor does it preclude non-intentional acts which give rise to different linguistic forms.

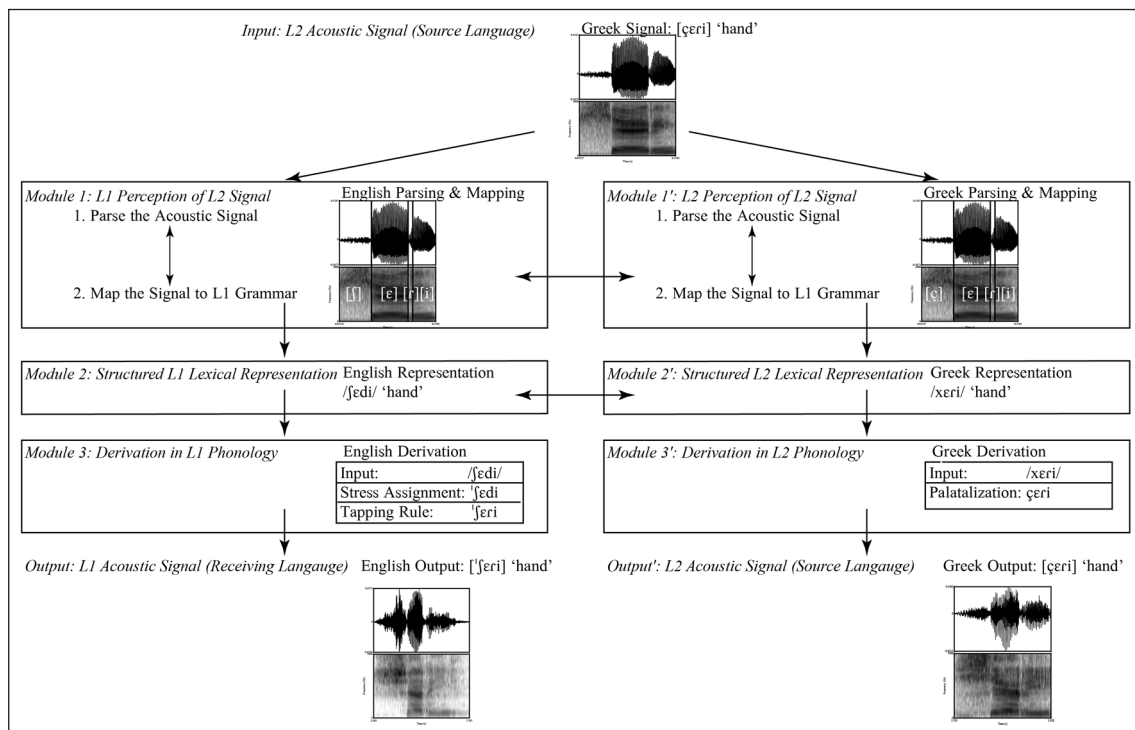


**Figure 1:** Loanword adaptation.

competence in an L1 and then later gained competence in an L2. Successive bilinguals are divided into the categories *early*, *mid*, and *late* depending on when they learned Spanish. In the vowel system of simultaneous bilinguals, Spanish /e/ and /o/ occupy the normal acoustic space of the Quichua vowels /i/ and /u/ thereby triggering the Quichua high vowels to rise and become more peripheral like the Spanish high vowels. This is observed in most early bilinguals and some mid bilinguals, but it is uncommon among late bilinguals. In contrast, late bilinguals and about half of the mid bilinguals exhibit the centralized Quichua 3-vowel system, and their Spanish /e/ and /o/ were often not distinguished from either the Spanish or Quichua high vowels. In terms of community-level linguistic agentivity effects, simultaneous bilinguals exhibit RL agentivity

in the heritage language whereby the heritage language's vowels system restructures in order to remain distinct from the contact language's mid vowels. Late bilinguals exhibit SL agentivity whereby the 3-vowel system of the heritage language restructures the contact language's system by collapsing the distinction between mid and high vowels. Early and mid successive bilinguals lie gradiently between these two extremes.

Bilingualism research emphasizes that bilingualism itself is gradient in nature (Grosjan 2001; Hernandez et al. 2005; Abutalebi & Green 2007; Kroll et al. 2015; de Bot & Bülow 2020). This literature predominantly investigates the syntactic and semantic properties of bilingualism, but its findings can be extended to the earlier typologies of loan phonology. Hernandez et al. (2005) stipulate that while some modes of bilingualism exist in which real-world stimuli are interpreted in the L2 only after they have been processed in the L1 (similar to **Figure 1** and SL Agentivity), speakers can strengthen their understanding of the L2 to a point where they can interpret real-world stimuli directly through the L2. As one's representation of the L2 strengthens, the link between both the L1 and L2 structures strengthen. At some point, the L1 begins to be interpreted through and influenced by the L2. Kroll et al. (2015) state that this influence is due to simultaneous activation of both representative structures. I propose that in RL Agentivity, the L2 affects the representation of the L1 because speakers can interpret an acoustic signal via both the L1 and the L2 regardless of the source language. This relationship is represented in **Figure 2**.



**Figure 2:** Model for advanced bilingual loan phonology.

Note that while the underlying mechanisms associated with each module are the same as in **Figure 1**, the arrows now link not only the processing sequence, but also the different systems which have access to information.

A consequence of the system represented in **Figure 2** is that signals intended to be interpreted in either the L1 or the L2 are actually interpreted in both. This results in a feedback loop where the use of one linguistic system calls upon the other and comparisons between how the structures in each system would categorize any given signal can be made. In line with the exemplar-based approach to emergent phonology (Wedel 2006; Garrett & Johnson 2013), this account assumes that if a listener receives many acoustic signals from the L2, the baseline structure of the L1's equivalent structure may begin to shift in small increments eventually resulting in gradual gestural drift. It follows that this exemplar-based gestural shift is especially probable in weakly supported L1 phonological structures that find more support in the L2 such as categories with low functional load and phonotactic restrictions (see section 2.1).

To summarize, the mechanisms underlying loan phonology adaptation can be extended to account for gestural shift if we add in an additional dimension of linguistic system representation as is done in **Figure 2**. Adding this extra dimension allows us to account for two additional properties observed in language contact literature: (1) instances where the L2 influences the L1 and (2) gradient incrementation of transfer effects.

## 2 The Plautdietsch speech community and contact phonology

This section presents an overview of the Plautdietsch speech community and how traditional social structures lead to a predictable distribution of novice and advanced bilingualism (**Figures 1** and **2** respectively). This section then compares the phonological structures of Mexican Plautdietsch and related communities to their nearest spoken contact languages.

### 2.1 Speech community social structure

Plautdietsch (a.k.a. Mennonite Low German) is an under-documented variety of Low German from present-day Poland known as Prussian Low German (Epp 1993). Netherlandic Mennonites, who originated in the Netherlands and Flanders, immigrated to Poland in the mid 16<sup>th</sup> century (Dyck 1993; Epp 1993), where they adopted Plautdietsch as their spoken language and a form of High German (similar to today's Standard German) as the language of religious services, education, and writing.<sup>2</sup> Polish Mennonites began settlement in Russia (present-day Ukraine) in the 18<sup>th</sup> century where the two major dialects, Chortitza and Molotschna, are believed to have developed (Quiring 1928).<sup>3</sup>

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<sup>2</sup> See Ostendorf (2018) for an alternative view of Plautdietsch's origins.

<sup>3</sup> See Burns (2021) for discussion of an alternative view of the dialect type origins.

Today, Plautdietsch enclaves are distributed over four continents (Europe, Asia, North America, and South America) and are always a linguistic minority in their respective regions. Across the different regions, Plautdietsch is the common heritage language which links many Netherlandic Mennonite communities together. One of the largest communities which maintains Plautdietsch is in Mexico with an estimated 90,000 native speakers as of 2015 (Burns 2016b: 11). The Mexican community developed in 1922 when conservative Russian Mennonites from Canada immigrated to Chihuahua (forming the first Latin American enclave). Descendants from conservative Canadian groups eventually expanded south into Durango and Zacatecas. The communities in northern Mexico splintered in three large outward migrations, first to Belize in 1958, then to Bolivia in 1967 (Lanning 1971), and finally to Texas in 1974.

Some Latin American Mennonite settlements do not come from the Mexican community. These communities are mostly located in South America (Paraguay, Brazil, and some parts of Bolivia) and came from Canada in 1926 and Russia in the 1930's (Burns 2018). South American descendants of the Mexican community are predominantly in Bolivia and Argentina.

Traditionally, Mexican Mennonites (and their descendants) live in communities that are physically and socially isolated from other demographics. The settlement in Texas is a notable exception because their attempt to construct a physically separate community failed for economic reasons (Elbow & Gordon 1981). Today, conservative members of the Texan community try to emulate physical distance by clustering together in certain neighborhoods. Plautdietsch in Texas went into decline shortly after the failure of the initial settlement (Elbow & Gordon 1981). My work with the community has shown that a steady stream of inward migration from other parts of Latin America has staved off language death with most community members immigrating from Mexico, and some entering from Canada, Bolivia, Belize, Paraguay, or Russia (via Germany).

Traditionally, Mexican Mennonites have prescribed gender-based language use. While all children learn Plautdietsch and (ostensibly) High German, only men are expected to learn the regional contact language.<sup>4</sup> Conversations with community members from 2007–2019 reveal that young boys in traditional communities learn Spanish by observing older male relatives interact with monolingual Spanish-speaking colleagues. Men can often be observed code-switching when they speak Plautdietsch, and community members are aware of this. This pattern of behavior suggests traditionally, men are expected to become advanced bilinguals resulting in competence similar to the model in **Figure 2**.

Women in traditional communities are not expected to learn the regional contact language and in many cases are actively discouraged. Women generally do not code-switch, but do employ

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<sup>4</sup> Community members who maintain ties with Canadian relatives expect all children to learn English. Conversations with speech community members from Belize indicate that English has made significant in-roads to many communities and Plautdietsch is being lost.



integrated loanwords. This suggests that women in traditional communities have a bilingual competence similar to novice bilingualism modeled in **Figure 1**. Women in the community are often viewed as guardians of non-religious cultural knowledge. This results in high social pressure on women to maintain customs and traditions including traditional or “correct” language.

Not all communities exhibit the full range of traditional behaviors, including the community in Texas. The younger generations that were born and raised in Texas are encouraged to speak both English and Plautdietsch regardless of gender. Some young members of this group have consciously chosen to speak English instead of Plautdietsch whereas others have simply noticed a gradual decline in their own use over time.

Contact languages are not always elevated to the social status of a heritage language within the community, especially if the contact language was not transmitted within the community, but rather learned by certain members of the community for utilitarian purposes. This is the case with the various forms of Mexican Spanish used in the Mexican community. Mexican Spanish is generally not viewed as a heritage language in Mexican Plautdietsch enclaves that live outside of Mexico (e.g. Belize, US). In this respect, the Mexican Plautdietsch enclave in Texas has Plautdietsch as a heritage language, Spanish as a historical contact language, and English as a present-day contact language.

## 2.2 Heritage and contact language phonemic structure

**Table 1** presents a composite Plautdietsch consonant inventory across different sources (Quiring 1928; Rempel 1995; Nieuweboer 1998; Naiditsch 2005; among others).<sup>5</sup> Affricates are listed in parentheses because while sources acknowledge their presence, their underlying phonological status is disputed.

	Labial	Alveolar	Post-Alveolar	Palatal	Velar	Glottal
Plosive	/p/ /b/	/t/ /d/		/c/ /ɟ/	/k/ /g/	
Nasal	/m/	/n/		/ɲ/	/ŋ/	
Fricative	/f/ /v/	/s/ /z/	/ʃ/ /ʒ/	/ç/	/x/	/h/
Affricate		(/tʃ/)	(/tʃ/)			
Trill/Tap		/r/				
Lateral		/l/				
Glide				/j/		

**Table 1:** Composite Plautdietsch consonant system.

<sup>5</sup> Variation in the palatal plosive series is a known dialectal feature (Quiring 1928; Tolksdorf 1985; Rempel 1995). This work represents palatals as the Chortitza variant as they were the speakers sampled in this work.

Some sources list  $\widehat{tʃ}$  as underlying (Lehn 1957; Cox et al. 2013), others treat it as a surface realization of biphonemic clusters (Naiditsch 2005), and others acknowledge its existence but remain neutral as to the phonemic status (Dyck 1964).<sup>6</sup> Regardless of whether or not affricates are underlying, they are a mental construct in some part of the phonological system and are consistently observed in different varieties. In section 1.1, I proposed that weakly supported phonological structures could be subject to gestural drift. A phoneme can be weakly supported for a variety of reasons such as low functional load, failure to have similar types of oppositions elsewhere in the phoneme system, and restricted phonotactic distribution. While any one of these alone may not make a segment a good candidate for gestural drift, a combination of these properties might.

I propose that  $\widehat{tʃ}$  is a mental reality, but similar to English  $/ʒ/$ , it is a phoneme which is weakly supported due to low functional load and few instances of contrast in the lexicon. A survey of the largest Plautdietsch dictionary (Zacharias 2009) shows that Plautdietsch has very few instances of lemmas with  $\widehat{tʃ}$  ( $n = 37$ ) and few which form minimal pairs with  $/ʃ/$  ( $n = 5$ ).<sup>7</sup>

The presence of additional affricates could potentially support the contrastive status of  $\widehat{tʃ}$  as distinct from both  $/t/$  and  $/ʃ/$ , but the evidence for a distinct  $\widehat{ts}$  phoneme is not strong. The segment  $\widehat{ts}$  is most commonly found in High German loans (e.g.  $\widehat{tsad}$ ] ‘note’ <  $\widehat{tsət}$ ] *Zettel*) and is otherwise not native to any variety of Low German.<sup>8</sup>

Plautdietsch has two agreed-upon post-alveolar phonemes:  $/ʃ/$  and  $/ʒ/$ . American English has more contrasts among post-alveolars ( $/ʃ, \widehat{tʃ}, ʒ, \widehat{dʒ}/$ ) whereas Mexican Spanish has fewer ( $\widehat{tʃ}/$ ). Neither English nor general Mexican Spanish have affricates outside of the post-alveolar series.

Different varieties of Spanish are undergoing changes affecting contrasts involving  $\widehat{tʃ}$ . According to Butragueño (2013), some central Mexican Spanish varieties are shifting the sub-phonemic representation of  $/j/$  thereby expanding either the post-alveolar series (e.g.  $\widehat{desʒerbar}$ )

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<sup>6</sup> Cox et al. (2013) present a more complex consonant phoneme inventory than is typical of most other Plautdietsch documentation. In my view, they do not provide a satisfactory justification of why their proposed set of underlying contrasts is larger than the sets found in most other sources (e.g. they recognize that glottal stops can be analyzed as epenthetic, but put them in the phoneme inventory anyways). Goerzen (1952) is inconsistent in his treatment of lexical items in the post-alveolar affricate class. In some cases, he treats it as a biphonemic cluster, whereas in others he treats it as a single segment (1952: 87, 98–107). Lehn (1957) treats affricates, which are fronted reflexes of the palatal plosives, as distinct from plosive and fricative combinations at the same place.

<sup>7</sup> In order to come to this number, I excluded instances of  $\widehat{tʃ}$  where  $[t]$  and  $[ʃ]$  cross a morpheme boundary and removed dictionary head-lemmas which are formed by the same morphological base (e.g. *Rutsch* ‘slide’ and *rutschen* ‘to slide’ are only counted once).

<sup>8</sup> Part of the reason why  $\widehat{ts}$  is seldom discussed in the literature is because the majority of the phonemic affricates found in continental West Germanic developed from the High German sound shift: one of the innovations defining the historical split between the Low German and High German languages. This innovation led to the development of a different set of affricates:  $\widehat{pf}$ ,  $\widehat{ts}$ , and sometimes  $\widehat{kx}$ . Some Low German literature openly assumes that use of the term “affricate” is a direct reference to this innovation (e.g. Höder 2014: 307).

*desyerbar* ‘to weed’) or the affricate series (e.g. [inj̥ɛksion] *inyección* ‘injection’). Mennonites do not have settlements in this region of Mexico, therefore these developments should not influence Plautdietsch. Porteño Spanish (spoken in Argentina, Bolivia, and Uruguay) is undergoing expansion of the post-alveolar series. In Porteño, /ʎ/ and /j/ have both merged as /ʒ/ as in [ʒave] *llave* ‘key’ and [maʒa] *maya* ‘Maya’ (Campos-Astorkiza 2012: 98). Porteño /ʒ/ sometimes devoices resulting in a manner contrast between /t̪ʃ/ and the emerging phoneme /ʃ/. Some parts of Paraguay exhibit merger of /ʎ/ and /j/. Unlike Porteño, these regions have an affricate /d̪ʒ/ realization (Lipski 2011: 81; Palacios 2016: 336) resulting in a voicing contrast between /t̪ʃ/ and /d̪ʒ/. Bolivia, Paraguay, and Argentina have Mennonite settlements that sometimes interact with the Mexican community and its Texan daughter settlement.

In the three languages discussed in this paper, Spanish and Plautdietsch exhibit phonotactic restrictions on the distribution on the /t̪ʃ/. Native Plautdietsch lexical items have /t̪ʃ/ non-initially (e.g. [klot̪ʃn̩] ‘clap INF’, [d̪iʃ] ‘German’). Spanish mostly has /t̪ʃ/ non-finally. Word-final /t̪ʃ/ in Mexican Spanish is usually found in loanwords from indigenous languages such as [tenot̪ʃ] *Tenoch* ‘proper name’ < Nahuatl, [maket̪ʃ] *maquech* ‘living beetle broach’ < Yucatec Mayan, and [akimpet̪ʃ] *A-Kim-Pech* ‘place name’ < Yucatec Mayan (cf. [kampet̪ʃe] *Campeche* ‘place name’ < A-Kim-Pech). English has the widest distribution of /t̪ʃ/ because it lacks word-position restrictions.

Mexican Plautdietsch-speakers produce variation in /t̪ʃ/, yet this variation is not reported in earlier sources (Moelleken 1966; 1987; Brandt 1992). American English doesn’t have much variation in the production of affricate phonemes, but Mexican Spanish is known to have regional variation (see section 3.3). The most widely reported realizations of Mexican Spanish /t̪ʃ/ are [t̪ʃ] and [ʃ], the latter being stereotypically associated with northwestern Mexico. This variety of Mexican Spanish is often referred to as [ʃiwaˈwense] *Chihuauense* ‘Chihuahuan’ after the state most commonly associated with the pronunciation: Chihuahua.

Mexican Plautdietsch has a variety of loanwords from Mexican Spanish including currency (Spanish [ˈpeso] *peso* ‘peso’ > [ˈpəɪzo], Burns 2016a: 89–90), food (Spanish [ˈtako] *taco* ‘taco’ > [ˈtako]), transportation (Spanish [ˈbuɾo] *burro* ‘donkey’ > [ˈbʊɾe]), social relations (Spanish [soˈbrino]/[soˈbrina] *sobrino/a* ‘cousin’ > [soˈbrino]/[soˈbrina]), and proper names (Spanish [ˈpant̪ʃo] *Pancho* ‘nickname for Francisco’ > [ˈpant̪ʃo] ‘nickname for Franz’). Zacharias’ (2009) dictionary indicates that some common nouns in Plautdietsch are now used alongside the equivalent Spanish loanword (e.g. Spanish [aˈɾaɲa] *araña* ‘spider’ > [aˈɾaɲə] vs. [ˈʃpand] ‘spider’, cf. High German [ˈʃpɪnə] *Spinne* ‘spider’). While some Spanish loanwords exhibit changes to fit the native Plautdietsch phonological system (e.g. [ˈpəɪzo] ‘peso’ < [ˈpeso] and [ˈbʊɾe] ‘donkey’ < [ˈbuɾo] *burro*), some phonetic differences between Plautdietsch and general Mexican Spanish reflect the Mexican Spanish donor dialect rather than a Plautdietsch phonological process. **Table 2** presents loanwords that I have encountered in the Mexican Plautdietsch community. American English borrowings from Mexican Spanish are provided for comparison.

Plautdietsch (Mexican)	Mexican Spanish (Chihuahuense)	Mexican Spanish (general)	English (American)	Gloss
[ˈtʃile]~[ˈfile]	[ˈfile]	[ˈtʃile]	[ˈtʃili]	‘chili’
[ˈʃaŋɡla]	[ˈʃaŋkla]	[ˈtʃaŋkla]	–	‘thong sandal’
[ˈvratʃ]~[ˈvraʃ]	[waˈraʃe]	[waˈratʃe]	[wəˈɹɑtʃi]	‘woven sandal’
[ˈranʃ]	[ˈran(t)ʃo]	[ˈrantʃo]	[ˈɹæntʃ]	‘ranch’

**Table 2:** Comparison of Spanish loans.

While the English words exhibit affricates like general Mexican Spanish, many of the Plautdietsch borrowings exhibit fricatives like Chihuahuense. This is true even when it appears like the lexical item might have been borrowed from Spanish via English like ‘ranch’.<sup>9</sup>

### 3 Affricates, deaffrication, and regional deaffrication

This section explores the synchronic and diachronic correlates of affricates (section 3.1). There are two different types of deaffrication: gradient and categorical. These types are characteristic of different languages in the contact situation. Categorical deaffrication is historically a Plautdietsch internal process (section 3.2) whereas acoustically gradient deaffrication is found in regional Mexican Spanish (section 3.3). Section 3.4 sets up the expectations of deaffrication of /tʃ/ from either source phonetically, phonologically, and socially.

#### 3.1 The structure of affricates and deaffrication

Affricates are articulatory gestures that combine the closure period of a plosive with the delayed release of a fricative.<sup>10</sup> Affricates differ from simplex plosives and fricatives of the same place and voicing in terms of (a) the duration of the closure, (b) the release amplitude, (c) the duration of the release, and (d) the amount of time it takes to reach the maximum amplitude of the segment.

All three obstruent types are characterized by high oral cavity pressure. Plosives and affricates build pressure behind a closure before a rapid release. Intervocalic closures for plosives can be longer than closures for affricates. Fricatives are produced with a continual release of high oral pressure, and therefore lack a closure. Both plosives and affricates exhibit a rapid release of built up pressure resulting in a high energy burst. Languages vary with respect to whether plosives or affricates have louder releases (Kochetov & Lobanova 2007: 55; Kochetov & Sreedevi 2016). Both fricatives and affricates are characterized by a delayed release, but the noise period of

<sup>9</sup> Apocope in ‘woven sandal’ is likely related to the stress shift (cf. [ˈta.ko] ‘taco’ which lacks a stress shift and retains the final vowel).

<sup>10</sup> As the primary focus of this work is acoustic signal to phoneme mapping, I do not discuss the internal structure of affricates. Lin (2011) presents theoretical phonology approaches to affricate structure.

a fricative lasts longer than the noise period of an affricate because the high oral pressure is released through the entire production of the fricative segment. Plosives have the shortest noise period of the three obstruent types. Finally, fricatives and affricates are usually differentiated by amplitude rise time, or the amount of time it takes from the onset of the consonant to reach the maximum amplitude of the segment. **Table 3** summarizes the acoustic properties of plosives, affricates, and fricatives mentioned above.

	Plosive	Affricate	Fricative
Closure Duration	long	medium	none
Release Burst	varies	varies	none
Noise Duration	short	medium	long
Rise Time	none	short	long

**Table 3:** Properties of intervocalic obstruents.

Most studies find that speakers often rely on a combination of cues to identify the different obstruent types and obstruent sequences (Repp et al. 1978; Dorman et al. 1980).

Deaffrication occurs when an affricate loses the complex structure of the gesture. The most common type of deaffrication involves loss of the closure period resulting in a fricative as in French (Romance) [ʃɑ̃bʁ] *chambre* ‘bedroom’ (cf. English [tʃɛmbə] *chamber* < Old French), Mandarin (Sinitic) \*s-tsik > \*sit > [çi55] *xī* ‘knee’ (cf. \*ts<sup>s</sup>ik > \*tset > [tʃe35] *jié* ‘joint of bamboo’, Baxter 2016: 136), and Pipil (Uto-Aztecan) tsutsukul > susukul ‘water jug’ (Campbell 2013: 38).<sup>11</sup> Butragueño (2014) proposes that diachronically, this type of deaffrication develops from a gradual shortening of the closure duration (2014: 204), but Herrera Zendejas (2006) shows that there is a trade-off between the closure duration and the release duration suggesting that as the closure shortens, the release lengthens.

### 3.2 Historical deaffrication in Plautdietsch

Although deaffrication is not rare cross-linguistically, it is not a feature of any of the closest relatives of Plautdietsch including English, Dutch, and other types of Low German. The only known cases of deaffrication in Plautdietsch involve loanwords. High German loans with [tʃ] are variably realized with the native segment [s] (Rempel 1995: ix–x). In word-initial position [tʃ] can be deaffricated (e.g. [syɛx] ~ [tsyɛx] ‘train’, cf. Standard German [tʃuk] *Zug*

<sup>11</sup> Less commonly, deaffrication references loss of the sustained release as in Maninka (Mande) [tʃ] > [t] and [dʃ] > [d] (Diakite 2018: 16). Diakite may be assuming that [dʃ] comes from [dʒ], but he does not clarify this point. In the current work, deaffrication only references the spirantizing type.

‘train’), but non-initially, the closure and delayed release are preserved as in [mɛ̃ts̃] ‘cap’, cf. Standard German [mỹts̃ə] *Mütze* ‘cap’. Historically, non-native Russian [t͡ɕ] underwent variable deaffrication in word-initial position. The loan [t͡ɕimɛdan] *чемодан* ‘suitcase’ is consistently realized as [ʃɛməˈdon], whereas [t͡ɕɛtvʲirtʲ] *четверть* ‘quarter’ is consistently reported with the initial affricate intact (Baerg 1960, Dyck 1964). Loans with non-initial [t͡ɕ] preserve the affricate as in [krut͡ɕə] *круча* ‘cliff’ > [krut͡ɕ]. The older loanwords reflect the phonotactic properties of Plautdietsch which has a strong preference against word-initial affricates discussed in section 2.2. As was mentioned in section 2.2, the presence of additional affricates could potentially support the interpretation of affricates as fully contrasting with fricatives, but evidence from historical loanword adaptation suggests that the native Plautdietsch phonological system often overrode the contact-language’s phonological structures. The result is that word-initially, affricates and fricatives often neutralize.

My work with various Plautdietsch enclaves indicates that realization of word-initial [t͡ɕ] mostly depends on how well the individual knows Standard German from Germany (as opposed to the form of High German learned in traditional community schools). Individuals familiar with Standard German are more likely to realize the affricate (although this is not common in the Mexican community). Members of the Mexican community generally do not know Russian and therefore do not connect the initial [ʃ] in ‘suitcase’ with [t͡ɕ]. At the community level, there is only awareness of a few of token loans from Russian.

### 3.3 Deaffrication in northern Mexican Spanish

Deaffrication extends over a large contiguous geographical range in the northwest that includes Arizona, New Mexico, Texas, Colorado, Chihuahua, Sonora, Durango, and Baja California (Moreno de Alba 1994: 122; Lipski 2008: 86; Serrano 2009; Casillas 2012; Butragueño 2014; Méndez 2017; Mazzaro & González de Anda 2019; among others). States along the Gulf of Mexico, including Tamaulipas and Veracruz, also exhibit deaffrication, but they lag behind the northwest (Butragueño 2014: 328). Most studies analyze /t͡ɕ/-realization as a binary option between [t͡ɕ] and [ʃ] (Brown 1989; Casillas 2012; Méndez 2017; Carillo 2018; among others). Butragueño (2014) and Herrera Zendejas (2006) treat deaffrication as a continuum from [t͡ɕ] to [ʃ]. Butragueño (2014) analyzes the degree of deaffrication using ordinal categories while Herrera Zendejas (2006) uses gradient acoustic measurements (duration in ms).

Phonologically, deaffrication is more frequent intervocalically than word-initially (Butragueño 2014; Méndez 2017). Many studies report that the post-nasal and post-lateral environments show the most resistance to deaffrication (Méndez 2017; Carrillo 2018; López-Velarde & Simonet 2019), but Herrera Zendejas presents evidence against this view (2006: 558–559). She finds that in Sonoran Spanish, the closure is short with a long release in the phrase [al t͡ɕeβalo] *al chevalo* ‘to the boy’, similar to the intervocalic closure and release properties

in the phrase [la ʃeβala] *la chevala* ‘the girl’. The pattern for *al chevalo* is different in the conservative Mexico City dialect which has a longer closure and shorter release characteristic of a true affricate. This leads Herrera Zendejas to analyze the structure in Sonoran Spanish *al chevalo* to contain an excrescent segment resulting from the gestural overlap of /{l,n} + ʃ/ sequences rather than as a true affricate (Herrera Zendejas 2006: 564, 567–568). This implies that deaffrication targets affricates between two sonorant segments but there is resistance to the process word-initially.

Mexican Spanish-speakers are aware of deaffrication (Serrano 2009; Casillas 2013; Méndez 2017) often associating it with Chihuahua despite the fact that it occurs in other states and regions. Perceptual dialectology surveys indicate that Mexican Spanish-speakers identify Chihuahua as its own dialect region and often cite deaffrication as a salient feature of the variety. Some survey participants identify Chihuahuan Spanish orthographically as <Shihuahuense>, reflecting deaffrication in the spelling (Serrano 2009: 124).

Deaffrication in northern Mexico was documented in the 1970’s (Lope Blanch 1974: 24–27), but sociolinguistic research dates the innovation to the early 20<sup>th</sup> century. Women from Chihuahua and Sonora born from the 1940’s–1960’s exhibited higher rates of deaffrication than men born around the same period (Brown 1989; Amastae 1996 as cited by Méndez 2017: 247). This timing is important because, as stated in section 2.1, Plautdietsch-speaking Mennonites first entered northern Mexico in the early 1920’s and the first major outward migration began in the late 1950’s and continued into the 1970’s. According to these sources, deaffrication was present in northern Mexico before Mennonites migrated to Texas.

Although some Mennonite communities are in contact with other varieties of Spanish (e.g. Bolivian, Paraguayan, Argentine) these regions are not known to have deaffrication of /tʃ/ (Lipski 2011; Campos-Astorkiza 2012).

### 3.4 How to Source Deaffrication

Documentation of Mexican Plautdietsch does not indicate deaffricated [tʃ] (Moelleken 1966; 1987; Brandt 1992), despite the fact that documentation began after the period implicated for the emergence of deaffrication in local varieties of Mexican Spanish. Failure to notice deaffrication may be due to sampling error, as many of these documents do not elicit words with the correct environment for this affricate to appear, or it could be because the innovation had not developed in Mennonite communities. In order to understand where deaffrication comes from, we need to answer the questions presented in (1).

- (1)
  - a. Is deaffrication gradient or categorical in nature?
  - b. Does deaffrication follow a particular phonological profile?
  - c. Is there a social pattern of deaffrication?

The answers to these questions are associated with two distinct linguistic profiles: categorical deaffrication, which is reported in Plautdietsch loanwords, vs. gradient deaffrication, which is typical of northern Mexican Spanishes. The first type predicts word-initial deaffrication, as historical loanwords exhibit a phonotactic restriction disfavoring affricates in this position, whereas the second type predicts word-medial deaffrication. These two profiles are summarized in (2):

- (2) Profile 1: Internally motivated deaffrication should (a) target affricates word-initially, and (b) exhibit categorical changes.  
 Profile 2: Contact motivated deaffrication should (a) target affricates word-medially, and (b) exhibit gradient changes.

Although studies on Mexican Spanish implicate women as the early leaders of deaffrication, it is important to note that in traditional Mexican Plautdietsch enclaves, only men interact with community outsiders (see section 2.1). This suggests that if deaffrication is related to contact, rather than an extension of the preexisting internal process, it will not only exhibit phonetic/phonological structures similar to northern Mexican Spanish, but men should exhibit more deaffrication than women. This is because men reach advanced bilingual competence, wherein speech signals can be processed across two established language systems (see section 1.1 and 2.1), whereas women have novice bilingual competence, wherein there is no independent Spanish system and all Spanish signals are interpreted through the Plautdietsch system.

## 4 Methodology

This section outlines the survey of a Plautdietsch enclave in Texas. Many members of this speech community are the descendants of the northern Mexican community, but this region also serves as an outpost for speakers traveling along the community's migration path. Section 4.1 provides the demographic information of the consultants, section 4.2 explains the elicitation methodology, and 4.3 explains the data analysis methodology.

### 4.1 Study time and participants

Thirteen fluent native speakers of the Chortitza Plautdietsch dialect were recruited to participate in this survey (F = 8, M = 5) in the 2018–2019 academic year.<sup>12</sup> While this number of consultants may seem small, studies with the Plautdietsch speech community that report higher numbers usually require the researcher to run the project over a multi-year period in different locations (see Kaufmann 2011; Burns 2016b). This was not possible because the researcher's family had to pay for this research out of pocket.

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<sup>12</sup> Although Burns (2016b) challenges whether or not the Molotschna vs. Chortitza divide truly exists, it is possible to identify the descendants of each group based on migration patterns. The Molotschna variety is moribund in the US.



Consultants were recruited based on participation in previous research and snowball sampling. The researcher tried to get a gender-balanced sample, but men tend to have lower rates of participation in some regions (see Kaufmann 2011; Burns 2016b). The researcher tried to include consultants who had lived in different regions of the Plautdietsch-speaking world as controls.

**Table 4** provides the alpha-numeric identification code and social attributes of the consultants. The column “from” represents the locations where consultants report they are from. An underline in this column represents which location the consultant associates with their formative years. Information about education and occupation is not included in the summary because it was not relevant to the overall distribution of the data in the sampled population.

Consultant	Gender	Age	From	Other Spoken Language:	Consultant Notes
TX02	F	49	<u>Texas</u> , Chihuahua	English, High German	Distant relative of TX12, Relative of TX17
TX04	F	27	<u>Texas</u> , Chihuahua	English	Relative of TX13
TX12	F	54	Texas, <u>Chihuahua</u>	English, High German	Distant relative of TX02
TX13	F	34	<u>Texas</u> , Chihuahua	English	Relative of TX04
TX14	F	65	Chortitza, <u>Kyrgyzstan</u>	High German, Russian	Migration path visitor
TX15	M	55	Texas, <u>Chihuahua</u>	English, Mexican Spanish	
TX16	F	25	<u>Texas</u>	English	Only one parent speaks Plautdietsch (father from Belize)
TX17	F	52	Texas, <u>Chihuahua</u>	English	Relative of TX02
TX18	F	71	<u>Canada</u> , <u>Paraguay</u>	English, High German, Paraguayan Spanish	
TX19	M	69	<u>Chihuahua</u>	English, Mexican Spanish	
TX20	M	61	<u>Tamaulipas</u>	English, Mexican Spanish	
TX21	M	31	<u>Texas</u>	English	
TX22	M	18	<u>Texas</u>	English	

**Table 4:** Consultant attributes.

Older men in this survey reported proficient learning of both English and Spanish, whereas older women tended to learn English and some Standard German by interacting with speakers from Germany. It is not common for fluent speakers of Standard German from Europe to interact with the Mexican Mennonite enclaves, but it does occur (e.g. TX14 is a fluent speaker of Standard German). More often speakers from the Mexican enclaves are exposed to a form of High German which is specific to Mennonite communities. The one older woman who knows Spanish is from a Canadian family that lived in South America as missionaries. Canadian groups tend not to have the same gender restrictions on regional language use as the Mexican group. It is common for young women from Canada to learn Spanish if they settle in a Spanish-speaking country. The younger men, like the younger women, reported proficiency in English, but neither reported proficiency in Spanish.

## 4.2 Elicitation

Data were collected in a task designed to investigate the acoustic and articulatory properties of fully occlusive segments. Consultants produced tokens of /t, k, tʃ, c, ʃ, ɲ/ word-initially and word-medially with the target vowel /a/. This study did not elicit tokens of /ʃ/ because of time and scope considerations of the original survey (consultants tend to agree to tasks which should take no longer than 45 minutes). Each target combination was produced twice totaling 24 target utterances. Although /tʃ/ does not natively occur word-initially, inclusion of this sequence allows us to test which type of deaffrication process, if any, speakers use in this novel context. If deaffrication is applied in this novel context more than the medial context, there is evidence that the speaker's deaffrication follows the historical Plautdietsch internal deaffrication. If there is not deaffrication in this novel context, but there is deaffrication in word-internal contexts, there is evidence that the speaker's deaffrication follows the Mexican Spanish pattern (see section 3.4). Consultants did not encounter difficulty structuring the target utterance in this position as if it were in a Plautdietsch word.

Consultants were given a phonemic substitution task. They were first presented with a word to translate into a native Plautdietsch target word. After getting the correct translation, they were guided to isolate the target sound in the word and put it in the correct vocalic context for each trial. Consultants had access to a sheet of paper to guide them through each stage of the elicitation. The consultants were reminded that the goal was to say the sounds as they naturally would in Plautdietsch and not as others would say the sound (including the researcher).

In the past, consultants have reported self-consciousness due to a lack of formal training in Plautdietsch. Providing written target forms helps put consultants at ease, although most consultants in this study, and previous studies, ignored the writing and followed the researcher's

spoken instructions instead. Plautdietsch lacks a standard orthography, so the author used Rempel's (1995) system for the written forms on the paper.<sup>13</sup>

As the elicitation was aimed at documenting both acoustic and articulatory properties of Plautdietsch, all target utterances were produced with an edible charcoal paint for static palatography and linguography. Given the nature of this task, the speech represented in this investigation is careful and attentive. As a result, the behaviors observed in this survey may reflect more historically conservative patterns rather than the type of speech which may be exhibited among the same population if they were to speak in either a casual or inattentive style.

Sessions were often done in a consultant's home, usually with friends and family present. Consultants had the option to conduct the session in either American English, general Mexican Spanish, or Standard German. All consultants selected English except for TX14 whose session was conducted in Standard German. After the production task, social data were collected in a questionnaire that is a modified version of the Texas German Dialect Project's social survey tool (see **Table 4** for results).

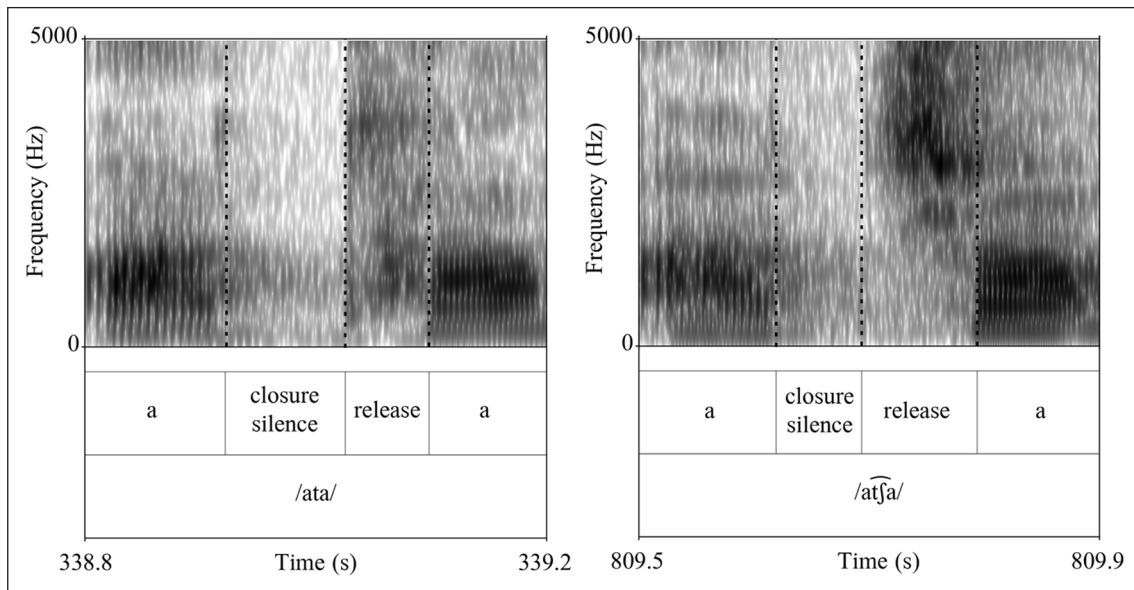
### 4.3 Data management and analysis

Sessions were recorded as uncompressed wav files on a Zoom H4n with built-in microphones at a sample rate of 44.1 kHz. All wav files were annotated in Praat (Boersma & Weenink 2019). All utterances with the elicited target sequences were coded to be included (sometimes consultants produced multiple target utterances due to smearing the paint). Utterances with too much interference from ambient noise were removed. Medial closures were measured as the silence period from the offset of a vowel to the release burst of a consonant. Alternatively, if there was no visible release burst, the closure was measured from the offset of a vowel to the onset of visible frication. Segment release duration was measured from the initial noise period to the onset of the adjacent vowel.<sup>14</sup> **Figure 3** provides a sample of the segmentation for a target /ata/ sequence (left) and /at̪a/ sequence (right) produced by TX17. The dashed lines represent a discrete segmentation boundary.

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<sup>13</sup> In the past and in this study, consultants have provided alternative translations to written Plautdietsch answers or have had difficulty producing a Plautdietsch translation even though an orthographic representation was in front of them. In the past, some consultants have commented on Rempel's orthography by offering alternative spellings based on their own pronunciation. Zacharias' (2009) orthography was not used for two reasons. (1) It encodes phonological innovations that are unique to specific subsets of the Plautdietsch community and (2) some phonemes in the high vowel system which are systematically differentiated across all groups according to Burns (2016b) are not differentiated in the orthographic system. The author's concerns about the orthography were independently confirmed by TX12 who is familiar with variation in the different orthographic systems.

<sup>14</sup> Aspiration was included in the release duration measurements because some categories encode important cues during the aspiration period.



**Figure 3:** TX 17 obstruent segmentation, (a) /ata/ (b) /atʃa/.

As discussed in section 3.1, there are a variety of different acoustic cues involved in signaling the difference between different types of obstruents. In this study, I analyze the acoustic cue of duration because the literature on phonetic properties of the diachronic process of deaffrication only references duration. To the author's knowledge, there are currently no studies on the diachronic process of deaffrication as it relates to changes in either amplitude rise time or burst amplitude. This study does not seek to fill this gap because bursts can be difficult to classify when they are not strong and rise time readings can be altered due to ambient noise in the elicitation setting (e.g. body shifting, placement of objects on surfaces, wind, children, etc).

Information from 209 utterances (affricate = 52, plosive = 157) was stored in a spreadsheet with consultant metadata. Information about release duration was stored for every utterance and information about closure silence duration stored for every word-medial utterance. Based on the data presented in section 3.1 (cf. **Table 3**), the release for a plosive should be shorter than the release for an affricate. While TX17 exhibits aspiration in her plosive, it is still the case that the overall release durations in these samples follow the expected behavior. Target /t/'s release is 67 ms whereas target /tʃ/'s release is 106 ms.

As can be seen in **Figure 3**, which represents two word-medial tokens, both the target plosive and affricate exhibit a full oral closure where pressure is built up prior to a release. As discussed above in section 3.1, the closure period for a plosive is expected to be longer than the closure for an affricate. This is borne out in **Figure 3**; /t/'s closure duration is 96 ms whereas /tʃ/'s is 78 ms. We can imagine a scenario where possibly the release duration of either an affricate and a plosive or an affricate and a fricative are not clearly distinguished without the additional cue of

the closure duration. For this reason, I created a third measurement which is the mathematical difference between the silence period and the release period which I call  $\Delta sr$ . The /t/ token shown in **Figure 3a** has a  $\Delta sr$  of 29 ms (96–67) whereas the /tʃ/ token in **Figure 3b** has a  $\Delta sr$  of –28 ms (78–106). Given that fricatives have the longest duration of all obstruents and the shortest closures (or a complete lack of a closure), these realizations will have the largest negative  $\Delta sr$  value of all obstruent closures.

Much like closure durations,  $\Delta sr$  values only exist for utterances with the target segment in word-medial position making this a phonological context-dependent measurement. This is because the acoustic signal does not contain cues as to when the closure silence period begins word-initially because this gesture is preceded by silence in the recordings. Given the lack of initial  $\Delta sr$ s for comparison, we can only interpret regional Spanish influence if men exhibit higher rates of deaffrication than women. This is because while access to Mexican Spanish, which deaffricates in this position, is historically available to men and not women, the historical Plautdietsch deaffrication pattern predicts that, men and women should exhibit no differences in behavior in medial position.

Summary statistics and their corresponding visualizations were produced in R. The visualizations were edited in Adobe Illustrator for readability. The significance of the summary statistics were checked using a Welch’s two sample t-test (henceforth “t-test”) when only two-means were compared and linear models when multiple means were being compared. In addition to this, the author constructed multiple mixed-effects models using the package lme4 (Bates et al. 2015) and subsequently compared them with an ANOVA.<sup>15</sup> Because the overall number of sampled individuals and token utterances are rather small, significance results from the t-tests and ANOVA should be understood as providing cursory information about community structure which can be more robustly tested in follow-up studies with a larger population sample.

## 5 Results

Section 5.1 presents the findings of group and individual production of the affricate /tʃ/. Section 5.2 reports which mixed-effects models best accounted for the data. Section 5.3 discusses the results with respect to the questions outlined in (1) in section 3.4. As mentioned in section 4.3, the significance reported in this section should be interpreted as only one type of evidence used to understand the community’s structure. There are other trends in the data which may not rise to the level of statistical significance due to the small sample size, and other types of behaviors that are non-quantifiable (e.g. comments, interactions), which are also important to consider

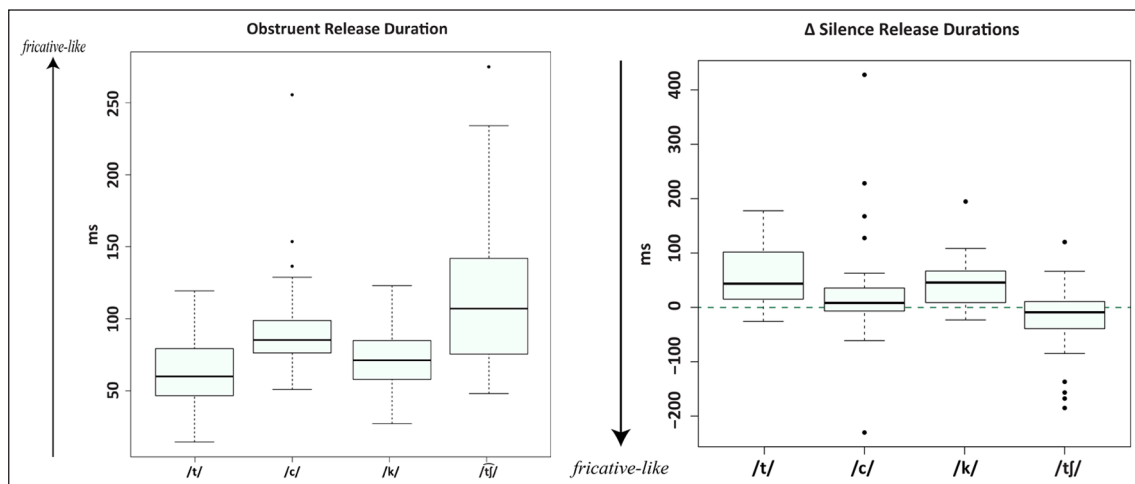
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<sup>15</sup> While there is the possibility that reported p-values and model fit metrics may arise due to the small sample size, the overall trends and patterns observed are consistent with the author’s interaction with the Mexican speech communities and their enclaves which first began in 2007.

when interpreting the behaviors observed in the community. For this reason, in this section, I discuss all observable variation in the data in addition to calling attention to the variation which rises to the level of statistical significance in this small sample.

## 5.1 Summary of release duration

Target plosives and affricates had different release durations as shown in **Figure 4**. **Figure 4a** (left) shows the release duration of all sampled occlusives. A longer release duration is more typical of a fricative whereas a shorter release duration is more typical of a plosive (see sections 3.1 and 4.3). **Figure 4b** (right) shows the  $\Delta sr$  measurement outlined above. As mentioned in section 4.3, segments which have longer releases than silences (negative numbers) are more fricative-like whereas segments which have longer silences than releases (positive numbers) are more plosive-like.



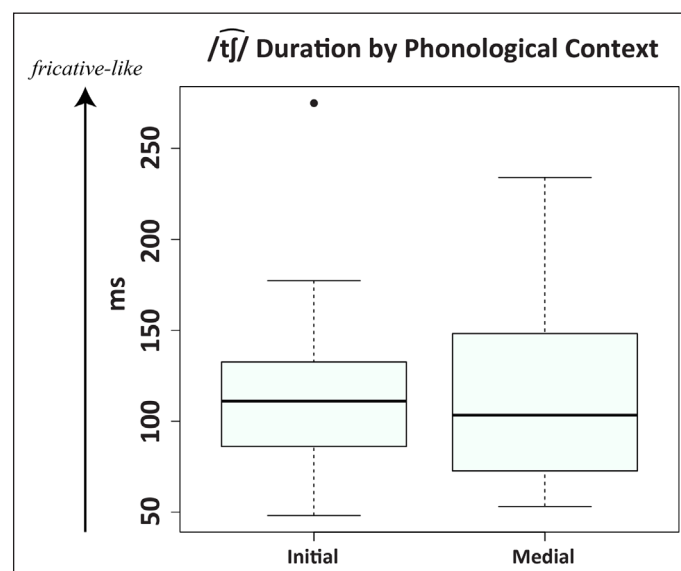
**Figure 4:** (a) Release by obstruent type, (b)  $\Delta sr$  by obstruent type.

The release durations of /t/ and /k/ owe most of their variation to aspiration ( $t\mu = 63.7$ ,  $k\mu = 70.9$ ). In a linear model that predicts release duration based on obstruent type, /t/ and /k/ are not significantly different ( $p > 0.05$ ). The plosive /c/ has a wider range of release durations ( $c\mu = 90.7$ ,  $c\sigma = 31.6$ ) which is statistically different from both /t/ and /k/ in the linear model ( $p < 0.05$ ). Variation in /c/ is due to a variety of secondary co-articulations and some affricate-like releases. The affricate /tʃ/ exhibits the highest average release and the widest distribution of variation ( $t\check{c}\mu = 113.8$ ,  $t\check{c}\sigma = 47.3$ ). The release of /tʃ/ is significantly different from all other sampled voiceless obstruents ( $p < 0.05$ ) in the linear model.

There is a question as to whether or not we should rely on release duration as listeners tend to use a variety of cues for identifying affricates with respect to other obstruents. As mentioned in section 3.3, many studies of deaffrication in north Mexican Spanish measure the silence period of

$\widehat{tj}$  as a metric of deaffrication, but Herrera Zendejas (2006) shows that there is an asymmetrical trade-off between the silence and release duration suggesting that the release might be a proxy for deaffrication. While the sampled Plautdietsch silence periods are not distinct from one another, the  $\Delta sr$  closely resembles the raw release data in a linear model. In a linear model that predicts  $\Delta sr$  based on obstruent type,  $\widehat{tj}$  significantly differed from all other sampled voiceless obstruents ( $\widehat{tj}\mu = -24.29$ ,  $p < 0.05$ ). Because both the release measurements and the silence release differences reliably distinguish  $\widehat{tj}$  from all other sampled obstruent categories, this study will consider release durations as a proxy for deaffrication. This is necessary because release data is available for all sampled utterances regardless of word position whereas  $\Delta sr$  is positionally restricted.

Deaffrication in Mexican Spanish and in historical Plautdietsch has context sensitivities. In Mexican Spanish, deaffrication is most pervasive intervocalically whereas in Plautdietsch, loanword deaffrication is word-initial. **Figure 5** presents  $\widehat{tj}$  release duration by phonological context.



**Figure 5:**  $\widehat{tj}$  release by word context.

Even though word-medial contexts exhibit slightly more variability in duration than initial affricates (initial  $\sigma = 46.54$ , medial  $\sigma = 48.16$ ), a t-test did not yield statistically different results between the means of these categories ( $p > 0.05$ ). This means that word-position alone is not an explanatory factor for release duration in these sampled data.

**Figure 6** shows differences in production based on social categories female (F) and male (M).

On average, men usually exhibit longer release durations than women ( $M\mu = 128.85$ ,  $F\mu = 105.71$ ), but similar to phonological context differences, the production differences between the two social groups are not statistically significant when tested in a t-test ( $p > 0.05$ ).

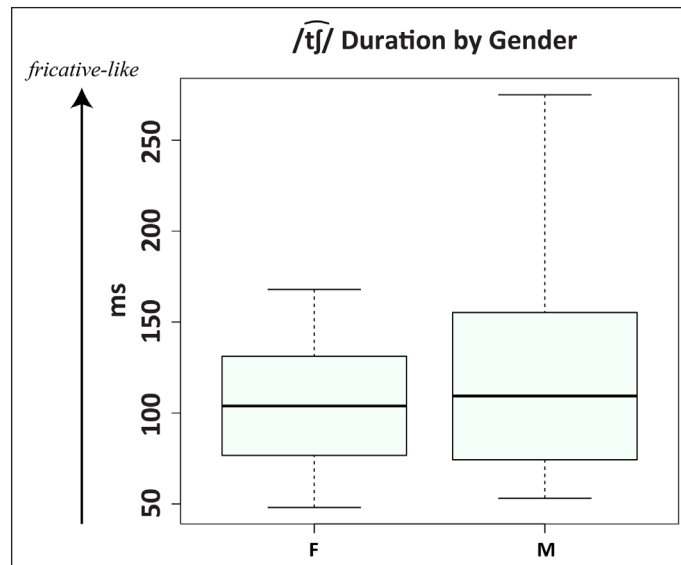


Figure 6:  $\widehat{tʃ}$  release by gender.

While the statistical measurements of Figures 5 and 6 suggest that neither word position nor gender influence the realization of affricates as was originally hypothesized, this appears to change when we consider gender and phonological context-sensitive measurements of deaffrication together. Figure 7a (left) shows release data for different genders in different phonological contexts. Figure 7b (right) shows the  $\Delta sr$  of the medial context.

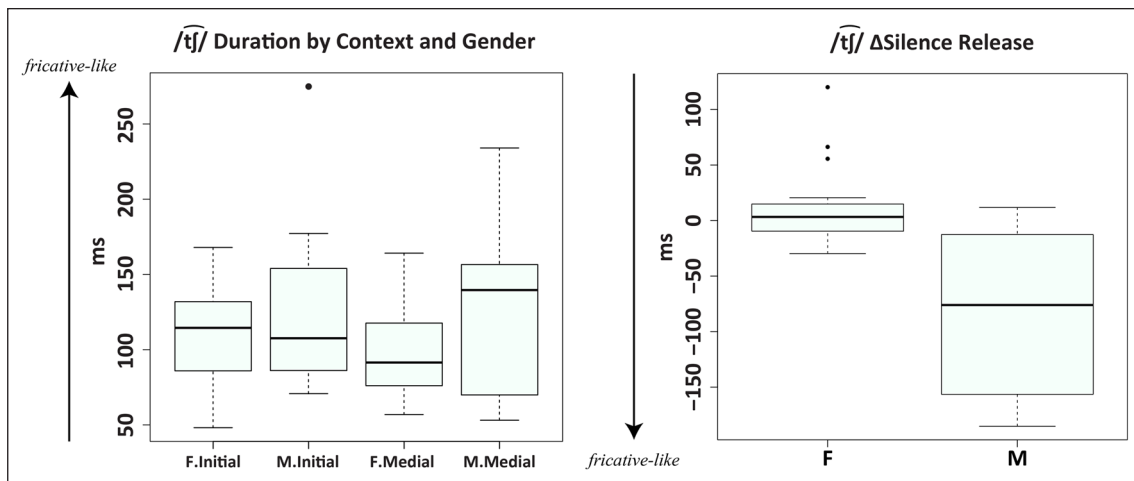


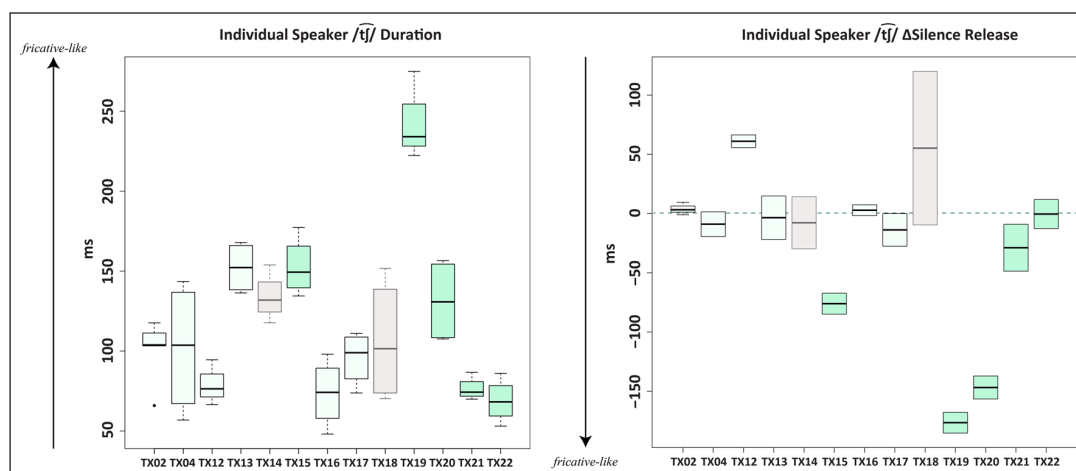
Figure 7: (a)  $\widehat{tʃ}$  release by gender and context (b)  $\widehat{tʃ}$   $\Delta sr$  by gender.

Within gender comparison reveals that men produced similar release durations in the different phonological contexts (medial +10 ms) as did women (initial +10 ms). When we look at how men and women perform in the same phonological context, word-initial position



has similar release durations, but word-medial position differs (men + 30 ms). While the release durations in **Figure 7a** are not statistically significant in a linear model that predicts release duration as a function of the interaction between gender and word context, when we consider the context-sensitive measurement  $\Delta sr$  across genders shown in **Figure 7b**, a t-test identified a statistically significant effect ( $p < 0.05$ ) between men and women. Men had a more fricative-like production with longer release durations than silence, but women had roughly equal release durations to silence. This means that if Plautdietsch had a word like Spanish [t̪arko] *charco* ‘puddle’, we might expect that the only measurement available in this context (release duration) would exhibit similar rates of deaffrication among men and women. However, if Plautdietsch had a word like Spanish [at̪a] *hacha* ‘hatchet’, the duration of the release with respect to the silence period would exhibit more deaffrication among men than women. Based on the data presented in **Figures 4–7** the realization of /t̪/ seems to be restricted based on a combination of social traits and phonologically dependent measurements.

In addition to group trends, it is important to examine individual behavior. **Figure 8a** presents each consultant’s release durations across all utterances whereas **Figure 8b** shows their  $\Delta sr$ . The counts for individual speakers are small, so significance is not reported. **Figure 8b** has the smallest observance count per individual and is only shown to contextualize the behavior observed in **Figure 8a**. Consultants in grey are not from a Mexican Plautdietsch background (TX15, TX18), although it should be noted that TX16’s family is one step removed from Mexico via Belize. Women from a Mexican Plautdietsch background are in light green and men from a Mexican Plautdietsch background are in dark green.



**Figure 8:** (a) Individual /t̪/ release duration (b) Individual /t̪/  $\Delta sr$ .

When we look at individuals in **Figure 8**, the picture becomes more complex. Men have a very sharp split in production whereas women have a more gradient spread. The men with the

highest release averages and lowest  $\Delta$ srs are TX15, TX19, and TX20 whereas the men with the lowest release averages and highest  $\Delta$ srs are TX21 and TX22. This means that the men in the first group deaffricate more than the men in the second group.

The men in these two groups can be partitioned by age with respect to when the community migrated to Texas. The first cohort is between 50 and 70 and were born before the community migrated to Texas in 1974. They belong to an older more traditional generation which grew up in Mexico where men were expected to learn Spanish and serve as go-betweens with outsiders. The men in the second group are between 18–40 and were born after the community's migration to Texas. Both men in this group are from Texas. TX22 is very confident in his Plautdietsch and speaks it daily while TX21 doesn't use the language as much as he used to. Like many younger men in the community, neither have a discernible Plautdietsch accent when speaking English. In the production task, both exhibited reanalysis of the palatal series /c/ and /ɲ/ to the sequence /k + i/ and /ŋ + i/. Notably, these two phonemes are not present in English and the closest match in the English system is a velar segment plus /i/. This suggests that the two younger men use an English-influenced Plautdietsch system.

When we look at the two age-groups of women from a Mexican background, the older group contains TX02, TX12, and TX17 whereas the younger group contains TX04, TX13, and TX16. In general, the older women have shorter release durations than younger women in **Figure 8a** meaning that older women have more affricate-like production. TX16 differs from the other two young women because her only Plautdietsch-speaking relative, her father, is one step removed from Mexico via Belize, which is an English-speaking country. All women show averages close to 0 in **Figure 8b** which is typical of affricate-like production.

Although TX13 has an affricate-like production in **Figure 8b**, **Figure 8a** shows that she has longer release durations typical of fricatives similar to TX15. In casual conversations outside of elicitation, TX13 produced fricatives for  $\sqrt{tj}$ . TX04, the younger sister of TX13, exhibits more variation in her production in **Figure 8a**. TX04 is a friend of TX02, who consistently has a more affricate-like production. TX02 has commented on TX04's fricative production in the past. Older women in the Mexican group seem to be aware of deaffrication whereas men and younger consultants are less aware. During TX20's elicitation session, his wife tried to coach him to produce an affricate rather than the fricative. In spite of her explicit instruction, TX20 did not understand how his wife's production differed from his own and still produced fricatives.

The two consultants from a non-Mexican background exhibit behavior similar to the Mexican community, but the motivation may be different. TX14, who speaks both Russian and Plautdietsch, produced both /c/ and  $\sqrt{tj}$  similar to Russian  $\sqrt{tɕ}$ . This is a behavior that the author has encountered before outside of formal elicitation while visiting Russian enclaves in

Germany.<sup>16</sup> As can be seen in **Figure 8b**, TX14 produces a segment which is more like an affricate. Her long releases in initial position are similar to her releases in medial position suggesting that the long release durations observed in **Figure 8a** may not be due to deaffrication.

TX18 currently resides in the Texan settlement but during her formative years lived in Canada and Paraguay, where she learned Spanish. Paraguayan Spanish is not known to have deaffrication of /tʃ/ and if anything, regional South American Spanish should support the maintenance of a distinction between /tʃ/ and other post-alveolar oppositions (see section 2.2 and 3.3). Although TX18 has some long releases in **Figure 8a**, the variation in her speech is not dependent on phonological context. She consistently produced longer release durations in the second trial of each utterance. **Figure 8b** shows that both the short and the long releases are associated with an affricate-like production. The trial-dependent behavior exhibited by TX18 was not observed elsewhere in the sampled population and trial is not a significant predictor of variation.

In a linear model predicting  $\Delta sr$  based on age cohorts, older men form a statistically significant group. While younger females do not statistically differ from older females, their  $\Delta sr$ s trend in the direction of being more fricative-like. A linear model which uses only release duration as a proxy for deaffrication shows a similar structure to the situation outlined above among individuals who are direct descendants of the Mexican settlements (excluding TX14, TX16, TX18). In this model, older men, older women, and younger females all form groups which are statistically distinct from one another.

## 5.2 Mixed-effects models

Mixed-effects models were constructed to predict release duration of /tʃ/ and the  $\Delta sr$  with consultant as a random effect. The mixed-effects models for /tʃ/ release duration included a combination of social and phonological properties as fixed effects. The ANOVA detected two successful models. The first model, which has the best AIC fit, included the interaction of age and gender as fixed effects (AIC = -213.62, BIC = -201.91). The second model, which had the best BIC fit, only had Mexican Spanish as a fixed effect (AIC = -212.48, BIC = -204.68). Some models which included phonological context as a fixed effect performed well, but they had slightly poorer fits than models without this predictor. The predictor Mexican Spanish always improved a model's fit over those which had non-dialect-specific Spanish as a predictor. English was a poor predictor of variation because everyone sampled spoke English except for TX14. Models which included Mexican origin as a predictor did not perform well, even when considering the interaction between age and gender.

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<sup>16</sup> Speakers from the Russian community living in Texan enclave reported that their /c/ is different.

The mixed-effects models for  $\Delta sr$  only included social traits as fixed effects because the phonological context is already included in the dependent variable. Similar to the model for  $/\widehat{tj}/$  release duration, the ANOVA detected two successful models. The first model, which had the best AIC fit, included non-dialect-specific Spanish and the interaction of age and gender as fixed effects (AIC = -100.15, BIC = -91.079). The second model, which had the best BIC fit, included only the interaction of age and gender as fixed effects (AIC = -99.112, BIC = -91.337).

For both independent variables, the interaction of age and gender as fixed effects with speaker as a random effect always performed well. The difference in the independent variables arises when it comes to the role of Spanish(es) as fixed effects. In the models which predicted  $/\widehat{tj}/$  duration, Mexican Spanish always outperformed non-specific Spanish as a fixed effect. In the models which predicted the  $\Delta sr$ , Mexican Spanish performed better than non-specific Spanish in some models, but it did not outperform non-specific Spanish as a predictor when interaction effects were added. We should keep in mind that the model with the best AIC fit included Spanish and the interaction of age and gender meaning that the group of older Spanish-speaking men were in part responsible for the model's success. The members of this group are all Mexican Spanish-speakers.

### 5.3 Discussion

At the outset, I sought to discuss the relationship between two different types of contact-based phonological interference, loanword adaptation and gestural drift. While there were already reports of loanword adaptation in the Mexican Plautdietsch community, in order to discuss its relationship to gestural drift, it first had to be established that gestural drift had occurred. In order to establish the development of gestural drift in affricate phonemes, I investigated several properties of affricate realization in Plautdietsch provided in (1) in section 3.4 (reiterated in (3) below).

- (3)
- a. Is deaffrication gradient or categorical?
  - b. Does deaffrication follow a particular phonological profile?
  - c. Is there a social pattern of deaffrication?

While one cannot rule out that some individuals might make categorical leaps between affricates and fricatives, this study shows that binary binning may obfuscate the gradient nature of the process occurring in the Plautdietsch speech community. Gradient deaffrication is similar to the findings on Mexican Spanish deaffrication. Some individuals lengthen the release of the affricate (such as TX04 and TX13), resulting in a somewhat deaffricated production, while others lengthen the release of the affricate and shorten the closure duration (such as TX15, TX19, and TX20). By accounting for deaffrication as a gradient process, we are able to observe subtle sub-phonemic shifts in the population.

This study found evidence that older men deaffricate  $/\widehat{tj}/$  more than other groups in intervocalic context when  $\Delta sr$  is used as the measurement. This finding fits the Mexican Spanish deaffrication profile more than the historical loanword deaffrication profile which targets word-initial affricates. If the historical loanword deaffrication pattern were the predominant pattern found in the community, we would expect no gender or age-based differences in any of the word-medial deaffrication measurement types. The failure to find a model with phonological context as a necessary predictor of release duration can be interpreted in one of four ways: (a) the model would need to measure a different metric (e.g.  $\Delta sr$  in contextualized speech), (b) there wasn't enough release data across speakers, (c) a phonological pattern was not borrowed, but rather approximated, or (d) the input variety of Spanish itself had a trend in these two environments rather than an absolute differentiation. Most studies on Mexican Spanish report probability distributions across a wide range of speakers, and seldom try to categorize the behavior of individuals. This may obscure behaviors where some individuals may be near categorical [j] users whereas others exhibit positional sensitivity.

Deaffrication follows a complex social pattern. Older men have the longest release durations, but younger men have some of the shortest. Among women, the inverse pattern is found: younger women have longer release durations than older women. In word-medial context, older men have releases which are much longer than the closure period (fricative-like production), but everyone else exhibits closure durations which are closer to the release duration (affricate-like production). This social pattern is consistent with the community's historical access to language resources. **Table 5** summarizes the findings among consultants whose families are descendant of the Mexican group (excluding TX14 and TX18).

	<b>Born prior to Texan Migration</b>	<b>Born after Texan Migration</b>
Male	Proficiency in Mexican Spanish Most deaffrication	No proficiency in Mexican Spanish Least Deaffrication
Female	No proficiency in Mexican Spanish Least deaffrication	No proficiency in Mexican Spanish Some deaffrication

**Table 5:** Social profiles of deaffrication.

The upper left cell of **Table 5** contains the social traits which best predicted deaffrication in the mixed-effects models: older men, who are proficient Mexican Spanish-speakers. Older men from Mexico were expected to be fluent in the contact language (Mexican Spanish) and older women from Mexico were expected to remain functionally monolingual. In the younger generation, women behave like their older relatives (both men and women) and deaffrication is becoming acceptable. While it is possible that some younger women model their linguistic behavior on the norms of older female relatives, who are viewed as cultural and linguistic

heritage guardians, the behavior of TX04, TX13, and TX16 suggests that the behavior of older men serves as an important linguistic input. Even though TX16 doesn't exhibit deaffrication, she still behaves like TX04 and TX13 in that she models her language use based on older relatives, in this case her father from Belize who is her only Plautdietsch speaking parent. If she didn't model her speech on her father, she would not be a highly proficient speaker of Plautdietsch and would have abandoned the language like many other young adults her age. The two younger men, whose parents speak Plautdietsch, exhibit restructuring of their phonemic system in favor of English in some ways that were not observed in TX16 (see Section 5.1). The members of the speech community who are not from a Mexican background (TX14 and TX18) exhibit lengthened release durations which may not be associated with the process of deaffrication.

Finally, we should ask: what do the phonological and social patterns tell us about sub-phonemic change? The social patterning of deaffrication suggests that men who were heavily exposed to deaffricating varieties Mexican Spanish (e.g. Chihuahuense) introduced the Spanish-based pattern to Plautdietsch. This is likely because they are advanced bilinguals and possess strong representations of each language. As such, acoustic signals from either Spanish or Plautdietsch are parsed in both signal-mappings systems, and these systems can reciprocally influence each other. In this respect, when men hear [ʃ] in Spanish, they process it as Spanish  $\sqrt{tʃ}$ , which in turn informs the range of acceptable acoustic signals for Plautdietsch  $\sqrt{tʃ}$  allowing gestural drift to occur. Given that the Spanish [ʃ] occurs the most intervocalically, men would repeat this pattern their own Plautdietsch production. This likely could not occur with women of the same generation because they were novice bilinguals at best. Novice bilingualism would require the Spanish signal to be interpreted through a Plautdietsch system, but not the other way around. This means that when women hear [ʃ] in Spanish, they only ever interpret it as Plautdietsch  $\sqrt{s}$ . Any change in the behavior of women would require that either (a) a critical mass of women begin to learn regional Mexican Spanish, or (b) women shift their production of Plautdietsch  $\sqrt{tʃ}$  based on the input from men who have already shifted (similar to TX04 and TX13).

It is important to reiterate at this point that the type of task performed in this study elicited careful speech. It is possible that the pattern may be more widespread in the Mexican Plautdietsch community in casual speech, especially if the process of deaffrication is socially marked as it appears to be among some older women of Mexican descent.

## 6 Closing

Plautdietsch exhibits two types of phonological interference associated with the community's migration to Mexico. In one type, Mexican Spanish words are restructured to fit the native phonology of Plautdietsch (loanword adaptation) and in the second type native Plautdietsch words exhibit characteristics of regional Spanish deaffrication. I have proposed that these two

outcomes share many of the same underlying processing mechanisms, but crucially, differences in the representation of each language's phonological system leads to the different outcomes.

The mechanism for loanword adaptation involves the L1 informing the parsing, building of a structured representation, and production of any given signal from the L2. This is likely to occur when there is a weakly structured representation of the L2 due to low bilingual proficiency such as when Mennonites first settled in Mexico.

The mechanism for L1 gestural drift is similar to the mechanism for loanword adaptation, but critically it involves a stronger representation of the L2's phonological system typical of advanced bilinguals. Strong cognitive representations of the L2 allow both the L1 and the L2 to mutually influence each other. As the advanced bilingual listener experiences more stimuli from any given source, subtle sub-phonemic changes can develop in either the L1 or the L2. This type of subtle innovation may be especially likely if the stimuli from one language help to resolve an otherwise weak phonological contrast in the other (e.g. a contrast with low functional load, phonotactic restrictions, etc.).

Deaffrication, which is originally associated with northern and gulf coast Mexican Spanish-speakers, provides a window into the cognitive structures of contact-based gestural drift. After the Mexican Plautdietsch community underwent a phase of low bilingual competence at the onset of the settlement period, bilingual proficiency increased asymmetrically across the community due to social beliefs about gender roles. This investigation found that traditional prescriptive gender roles are associated with the social patterning of the borrowed deaffrication pattern. Individuals who exhibit acoustic cues consistent with deaffrication either gained proficiency in a deaffricating variety of Mexican Spanish at a young age (older men) or belong to a younger generation that has reinterpreted this property as a part of the Plautdietsch language (younger women). One may ask, whether or not this pattern should extend to the Plautdietsch of younger men as traditional gender roles in the community assume that younger men should receive more linguistic input from older men and in turn, their speech patterns should be similar to that of older men. The younger men in this study did behave like older men in so far as their speech patterns exhibited more influence based on the local contact language than younger women. This makes the deaffrication pattern unstable in the Texan community as American English, which does not support a processing-based extension of deaffrication, has replaced Mexican Spanish as the primary local contact language.

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## Competing Interests

The author has no competing interests to declare.

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