Variation in Non-native Speech: How Far Do Non-native Speakers Replicate Target Constraints on Variation? A Novel Approach

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Abstract: This paper introduces a new framework to analyze how non-native speakers adhere to native-speaker norms of variation in contact settings. The author focuses on a well-established phonological variable in both native and contact-induced varieties of English: consonant cluster reduction. This process involves either dropping or maintaining a final coronal stop (t,d) in a consonant cluster in words such as "mind" and "west." The paper uses standard variationist methodologies to establish the constraints on consonant cluster reduction in a native-speaker group (Wellingtonian English) and a non-native speaker sample (Arab migrants to Wellington). The study then compares these constraints, identifying any changes introduced by non-native speakers. The results show that the non-native group is highly attuned to dialect-specific aspects of variation and demonstrates a deletion rate close to native speakers. Additionally, they exhibit a strong transfer of target articulatory constraints related to consonant cluster reduction and acquire the social cues associated with this variation. Interestingly, these patterns of variation in non-native speech are consistent across similar non-native groups, irrespective of first language, proficiency in English, and the complexity of the target constraints on variation.

Keywords: contact settings, replication of constraints, transformation under transfer, variation in non-native speech, variation in a second language

1. Introduction

Contact settings present variationists with ample opportunities to discover variation in non-native speech, and variationist methodologies have been acceptable in this domain so far (Drummond 2011). Nevertheless, applying such methods is dominant in data analysis processes in variationist projects, and less uniformity exists in theoretical frameworks. Therefore, the literature on variation in non-native speech in contact settings reflects various perspectives. For example, some researchers studied stable variation among ethnic communities as a window to understand the process of second language acquisition. For instance, an analysis of consonant cluster reduction in African American vernacular, Chicano and Tejano Englishes in the United States revealed that speakers of these ethnic varieties have target-like constraints on variation (Cohen and Labov 1967; Fasold 1972; Otto 1996; Bayley 1996). In a similar vein to second language acquisition, Selinker (1972) introduced the concept of "interlanguage". The term refers to a set of intermediate, non-native-specific varieties of a target language that exhibit typical features. Second language

learners can only acquire certain aspects of variation at a certain interlanguage, as dominated by their developing proficiencies. For example, Adamson et al. (1996) illustrated that Spanish learners of English acquired target phonological constraints on consonant cluster reduction in the framework of tense marking in English. These learners were reluctant to delete past tense tokens because they were at a stage of second language learning where grammaticality was more important than sounding local.

To the best of my knowledge, one researcher compared the order of acquisition of target constraints on variation among non-native with that of native children (Edwards 2011). Native-speaker children are believed to acquire articulatory, grammatical, and social constraints, respectively (Labov 1989). Edwards (2011) suggested that native speakers of Mandarin, in a study abroad setting, seem to acquire articulatory constraints on consonant cluster reduction early on. In contrast, acquiring grammatical constraints is associated with their developing competence. Wolfram (1984; 1985) has reached a similar conclusion as he suggested that the acquisition of grammatical constraints is tied to non-native speakers' length of stay in a host country and their social network involvement. These two social factors essentially control proficiency in a second language. Wolfram (1984; 1985) explained that learners of a target language are more concerned about grammatical accuracy during early acquisition, and they start targeting local norms in later stages.

Drummond (2011) presents a more complex conceptualization of linguistic proficiency that informs our understanding of variation in non-native speech. He differentiated between two types of competencies. The first is linguistic competence, which includes acquiring basic target-variety forms. The second is sociolinguistic competence, which includes the acquisition of target-variety constraints on variation. The two competencies are intertwined, and a certain proficiency in linguistic competence is required to acquire native-like constraints on variation. For example, Polish teenage migrants to the UK could acquire variation in the target variety to varying degrees as enabled by their linguistic proficiency and social networks with the locals (Schleef, Meyerhoff and Clark 2011; Meyerhoff and Schleef 2012).

Recent work in variationist sociolinguistics considers variation in non-native speech compared to target variation patterns (Léglise and Chamoreau 2013). This work is essentially based on a twofold premise: firstly, non-natives notice target variables, social indices of variables, and linguistic and non-linguistic constraints on variation (Edwards 2011; Za'rour 2018). Secondly, that variation in non-native speech is systematic and rule-governed. In this tradition, researchers establish what constitutes a target variety to the non-native speaker and then analyze that variety for constraints on variation for a specific variable. The next step is to analyze non-native speaker constraints for the same variable and to consider how far non-natives replicate the established target constraints. The last step of comparing native constraints on variation against a native benchmark is the arena where more uniformity in research methodology needs to be established.

The present paper proposes a uniform theoretical and analytical framework to identify and track variation patterns among non-native speakers in contact settings. It draws on various theories and approaches to language contact and variationist sociolinguistics to create a reliable and replicable methodology to register how far non-natives replicate target variety constraints on variation in specific contact settings.

2. Literature review

Variation is a linguistic resource that speakers utilize to achieve sociolinguistic functions daily. In the variationist tradition, variation is typically modelled as a probability whereby one variant is more likely to occur in the context of social and linguistic factors (constraints). For example, if we consider consonant cluster reduction (which is the variable I am using to support the theoretical framework proposed in this paper), native speakers of English would either keep or drop the last consonant sound in an unstressed syllable so they would either say /west/ or /wes/, depending on several linguistic and social constraints. Variationists analyze the "vernacular" of speakers to unravel the underlying norms that govern variation in a linguistic variety. Specifically, they identify linguistic and non-linguistic constraints that predict the probability of one form (variant) occurrence rather than others in a specific context. The constraints are ranked according to the strength of effect each has on predicting the variant outcome. At every rank, a constraint is presented as a hierarchy of several lower-level factors (levels), also ordered according to their allocated effects, which is typically given as a numerical value called "factor weights".

The literature on variation in non-native speech suggests that non-natives are "inclined to replicate" some target constraints on variation, reinterpret, reject and create others (cf. Schleef et al. 2011; Meyerhoff and Schleef 2012; Za'rour 2018). The non-native experience essentially shapes the degree of replication of native norms in a host country. For example, young professionals and mobile people who live in multiethnic social hubs are less likely to accommodate native norms. These mobile professionals express their unique identities by making linguistic innovations that surpass variation to lexical innovation, syntactic innovation and even the introduction of new ethnolects (Mougeon, Nadasdi and Rehner 2005; Hornsby 2007; Wiese 2009; Britain 2010; Matras 2010; Mougeon, Rehner and Nadasdi 2010; Torgersen et al. 2011; Torgersen and Szakay 2012; Deshors, Götz and Laporte 2016; Matras 2020; Wei 2020; Ranta 2022). On the other hand, less mobile people who willingly live among locals replicate native speaker norms to a large degree. For example, Arab migrants to Wellington, New Zealand, replicate native norms to a large extent (Za'rour 2018).

Social factors also determine how far non-natives replicate native speaker norms on variation. A well-adjusted person with a positive attitude to a new environment is more likely to acquire target-like variation patterns. For example, Canada and The United States are considered multiethnic communities, but they do not necessarily present all non-natives with similar social experiences. I use the data

reporting on first- and second-generation migrants acquiring variation of a dominant target variety. In the first study, Boberg (2014) illustrated that Jewish migrants to Montreal who did not cluster in ethnic neighbourhoods tried to replicate the dominant target variety (British standards). On the other hand, Italian migrants to the same spot, who experienced residential and social isolation, illustrated ethnic marking in their speech. The Italian migrants perceived social segregation and ended up creating an ethnolect rather than accommodating the dominant target variety. These results imply that we cannot assume, a priori, that any contact setting (here wilful immigration) provides all non-natives with stable or similar social factor combinations. Another study illustrates how a Chinese community's self-identification as an ethnic minority and perceived isolation prevented them from acquiring target variation patterns (Hoffman and Walker 2010). Conversely, well-adjusted Chinese migrants to many U.S major cities adopted mainstream American English (Lo and Reyes 2004). Similarly, hostile social factors or perceived hostility in the contact setting may affect who non-natives perceive as their target group. For example, Puerto Rican immigrants to New York related to the African American experience of marginalization and social segregation. Therefore, they perceived the African American community of New York city as their preferred target group and have consequently acquired African American vernacular norms on variation rather than mainstream American English (Zentella 1997).

Another aspect that determines how far non-natives replicate native norms on variation is the constraint type and its complexity. Non-natives readily acquire articulatory constraints on variation, whereas grammatical, stylistic and social constraints are acquired much later (Edwards 2011; Za'rour 2018).

At this point, it is evident that non-native speakers will almost certainly impose changes on target constraints. With this in mind, I propose that non-natives who share specific social experiences and reside in low-linguistically diverse contact settings would exhibit similar variation patterns in the target language. This paper carries on the variationist tradition introduced above. It extends the application of a typology borrowed from contact linguistics, which tracks the degree of change imposed on a source language in a replica (originally a Creole). The typology introduces the concept of "transformation under transfer" (Meyerhoff 2009), which implies that the degrees of change imposed on target constraints (here, source language) are predictable and quantifiable in the replica (a creole). Meyerhoff (2009) suggests that:

> [t]his typology considers similarities both of kind and quality […] it allows us to ask linguistically and statistically meaningful questions about whether the same surface-level form found in two languages is, in fact, "the same." It adopts well-established terms from the field of language contact and attempts to relativize them to the kind of phenomena that variationists study.

Meyerhoff (2009) proposed three types of replication patterns, namely:

1. Weak transfer of target constraints on variation occurs when non-natives replicate the same statistically significant constraints found in the target variety. However, these constraints' rank order differs from the target rank order.
2. Strong transfer of target constraints on variation occurs when non-natives replicate the same statically significant constraints found in the target variety, maintaining the target rank order.
3. Calquing is the exact replication of target constraints on variation, with the same target rank ordering and internal hierarchies.

I propose to use this typology of "transformation under transfer" to identify and quantify the degree of change non-natives impose on target constraints. To test this theoretical framework's validity and replicability, the paper utilizes a stable, well-studied linguistic variable, i.e., consonant cluster reduction or, as typically referred to in variationist studies (t,d deletion). A stable variable, by definition, entails that a linguistic structure or form is not undergoing change and that the social and linguistic factors that determine its occurrence are stable as well. This is important for two reasons; the first is that I can confidently identify constraints on consonant cluster reduction in native and contact-induced varieties of English. Secondly, I can confidently assume that the sample non-native speakers (in this paper) have been exposed to more or less the same target variable as the native speakers. This would enable me to track the replication level my sample of non-native speakers illustrates on the constraints that condition consonant cluster reduction.

Consonant cluster reduction

Whether a speaker maintains or drops a word-final coronal stop, i.e., /t,d/ in words like "understand", is variable in native varieties of English. This variable is studied in native and contact-induced varieties of English, and the literature illustrates some reoccurring linguistic and social constraints as follows:

1. The preceding phonological context. This constraint includes a hierarchy of sublevels of sounds that occur before the final consonant stops. The literature suggests that preceding non-sonorant sounds are more likely to induce the deletion of the final consonant stops. On the other hand, preceding sonorant sounds seem to provoke full pronunciation of the final consonant stop. This constraint is usually reported to have a weak effect on consonant cluster reduction in native varieties of English.
2. The following phonological context. This constraint includes a hierarchy of sublevels of sounds that occur after the final consonant stop. Following consonants seem to provoke deletion, whereas following pauses and vowels encourage maintaining the final consonant (Guy 1980; Neu 1980; Guy 1991; Hoffman and Walker 2010). This constraint is usually reported to have the highest rank among other constraints that condition consonant cluster reduction in native and contact-induced varieties of English.

3. The morphological conditioning of a word or its grammatical category. Monomorphemes are more likely to host deletion word-finally than bimorphemic tokens like past tense tokens (Guy 1980; Neu 1980; Guy 1991; Tagliamonte and Temple 2005; Guy, Hay and Walker 2008; Hazen 2011). This is logical since deleting tense markings may jeopardize a sentence, whereas monomorphemes are retrievable from contexts. This constraint is dialect-specific as it is statistically significant in some dialects but not others (Tagliamonte and Temple 2005; Guy, Hay and Walker 2008; Hazen 2011).
4. The reoccurring social constraints on consonant cluster reduction among native speakers are gender and age. Women are less likely to drop word-final coronal stops (Holmes and Bell 1994), and there is a weak age-grading effect (Labov 1989; Guy and Boyd 1990; Roberts 1994; Smith, Durham and Fortune 2009). Non-natives are more driven by social factors that reflect how well-adjusted they are to a host country. If they are well-adjusted, they replicate target constraints. If not, they change target constraints or reject them altogether (Wolfram 1984; Wolfram 1985; Otto 1996; Bayley 1994; Bayley 1996; Patrick 1999; Edwards 2001; Drummond 2010; Hoffman and Walker 2010; Drummond 2011; Edwards 2011; Sharma and Sankaran 2011; Schleef 2013a; Schleef 2013b; Edwards 2016; Daleszynska-Slater and Meyerhoff 2020; Ryan 2021).

The main difference between native and contact-induced norms on consonant cluster reduction is the deletion rate. Native varieties of English delete final consonant clusters at a lower rate than contact-induced and non-native varieties of English. For example, Pan-American Englishes have a deletion rate of 33% (Guy 1991), British English has a deletion rate of 24% (Tagliamonte and Temple 2005), New Zealand and Australian English have a deletion rate of 31% (Holmes and Bell 1994), English based-creoles rates can be 75 percent (Patrick 1999), ethnolects like AAVE, Tejano and Chicano Englishes have a deletion rate of 50% (Patrick 1999; Edwards 2016). Therefore, I propose that the overall deletion rate is a dialect-specific aspect of consonant cluster reduction.

3. Methodology

The paper applies variationist methodologies to analyze variation in non-native speech. This part of the paper introduces the sampling of native and non-native respondents, the compiling, transcription and coding of two corpora, and the statistical analysis techniques applied. As hinted in the introduction and the literature review, the type of contact setting that non-natives experience inevitably affects how and who they perceive as the target variety. This experience also determines how much replication or change they apply to the target constraints on variation. This Paper uses Wellington, New Zealand, as the contact setting of interest. Firstly, Wellington is relatively small and less ethnically diverse than other migrant destinations like London, Dubai or Paris. It is an accepting and inclusive destination with two main ethnic groups, Māori (indigenous people) and pakeha (White British origins). The government is very invested in incorporating

minorities into the community to provide free English courses, career advice and even driving lessons to non-natives. At the time of data collection (2014-2018), The labour Party was in office, and they had established a diversity-accepting culture and raised the quota for refugee intake.

3.1 Sampling (native and non-native speakers)

This paper analyses the speech of a well-acculturated migrant group of Arabs to Wellington. This small group of three hundred Levantine Arab families willingly migrated to Wellington in the early nineties of the last century and are currently residing alongside the locals and not in ethnic neighbourhoods. The sample included male and female respondents representing first and second migrant communities to Wellington, New Zealand. I excluded potentially vulnerable respondents from the sample, especially Syrian refugees arriving in bundles at the time of data collection (2014-2016). The sample also excluded Lebanese respondents mainly because this community is very old in New Zealand and has established a separate identity from other Levantine Arabs.

After acquiring written consent from the target group, I interviewed twenty-one respondents for an average of an hour and a half. All the recordings were transcribed using ELAN, resulting in a non-native corpus. I then acquired access to audio recordings that were part of a project by Warren (2002) to create a corpus of New Zealand English. His data included Māori and Pakeha respondents from three main cities performing various tasks like reading sentences, explaining a map to an interviewer and themed interviews. These recordings are theoretically convenient to my research because they were made around the time of arrival of the non-native sample. I can, therefore, assume they represent the variety of Wellingtonian English to which the non-natives were exposed. I transcribed the raw recordings of the Wellington sample and excluded the Māori respondents from further analysis because Māori-English is a variety of New Zealand English that the migrants are less exposed to.

3.2 Corpus tagging of linguistic and social constraints on variation

After creating corpora to represent native and non-native speech, I started annotating the corpora. I ensured the reliability of corpus tagging by having a native speaker expert review all my work. I have also applied instrumental acoustic analysis, which visually represents the physical characteristics of speech sounds and makes it hard to miss the target variable. Moreover, as a native speaker of Arabic, I have an advantage in auditorily identifying instances of stops (glottal, deleted, devoiced, retained and reinforced final stops).

Regarding coding consonant cluster reduction, I have annotated the corpus for the linguistic and social constraints that have repeatedly been reported as statistically significant in the literature. The coding schema implemented for the variable is as follows:

1. The preceding phonological context constraint was coded to have five internal levels. These included: sibilant fricatives (/s/, /z/, /ʃ/, /ʒ/, /t ʃ/, /dʒ/), non-sibilant

fricatives (/f/, /v/, /θ/, and /ð/), nasals (/m/, /n/, /ŋ/), stops (/p/, /t/, /k/, /b/, /d/, /g/), and liquids (/r/ and /l/). I have not coded a preceding /r/ for native speakers due to their non-rhotic variety. However, I included preceding /r/ for non-native speakers because Arabic allows /rt/ and /rd/ syllable structures.

2. The following phonological context was coded to have six internal levels. These included sibilant fricatives (/s/, /z/, /ʃ/, /ʒ/, /t ʃ/, /dʒ/), non-sibilant fricatives (/f/, /v/, /θ/, /ð/), nasals (/m/, /n/, /ŋ/), stops (/p/, /t/, /k/, /b/, /d/, / g /), glides (/j/, /w/), vowels, pauses, and liquids (/l/ and /r/).
3. Grammatical category or morphological structure. Tokens with reduced consonant clusters were categorized based on the number of morphemes they are made up of and their function in a sentence. I used a coding system that classified words into bi-morphemes (such as regular past tense, negated forms, superlatives, and bimorphemic nouns) and monomorphemes. For function-based coding, I categorized words based on their parts of speech. When unsure, I referred to dictionaries and grammar books and consulted with native language experts. Examples from the data included words like judgment, advertisement (bimorphemic nouns), Auckland, New Zealand (proper nouns), ordinal adjectives, superlative forms, adverbs (e.g., fast), prepositions (e.g., beforehand, around, round, almost), regular past tense forms, and present tense forms.
4. Social factors included gender, age at arrival in the host country, length of stay in the host country, network involvement (for my sample, both Arabs and non-Arabs) and self-reported proficiency in English.

3.3 Statistical analysis

Once the two corpora were tagged for linguistic and non-linguistic constraints on the variable consonant cluster reduction, the data was converted into a spreadsheet and put through statistical analysis. This process was achieved using binomial logistic regression, which estimates the relationship between a dependent variable, i.e., the response (here, the application value chosen for a variable: dropped final consonant) and one or more independent variables, i.e., linguistic and social constraints on variation. A stepwise regression (step-up/step-down) employs a maximum likelihood algorithm that estimates the parameter (constraints/independent variables) of a statistical model's observations (observed token distribution) by finding the parameter's values that maximize the likelihood of achieving the observations given the parameters (Galili 2017). The output is then presented as a structure that displays specific pieces of information, including statistically significant constraints on variation, the rank ordering of constraints, and constraint internal hierarchies.

I used a statistical analysis package based in R, i.e., Rbrul, which is the accepted practice in variationist studies (see Johnson 2009; Johnson 2015). The mixed-effects modeling option available in Rbrul helps researchers control any intra-speaker variability or word-specific features that may cloud the interpretation of the results. Specifically, the tokens retrieved from a speaker may be all deleted

instances of consonant clusters because it is this person's preferred choice. Likewise, some words are more likely to host deletion because of their meaning or function. For instance, the word "and" most likely favours deletion because of its connecting properties between words and sentences.

I conducted regression analysis for the two corpora. First, a native-speaker benchmark was created, outlining all statistically significant and non-statistically significant constraints on the variable in Wellington English (including the deletion rate). Then, the same process was repeated for the non-native sample group. The final step was to analyze the findings from the non-native data against the typology presented earlier to identify the changes imposed on native constraints.

To summarise, the study applies variationist methodologies to:

1. Identify the linguistic and social constraints that condition variation on consonant-cluster reduction by native speakers of Wellingtonian English.
2. Identify the linguistic and social constraints that condition variation on consonant-cluster reduction by the non-native group.
3. Identify the degree of transfer of target variety constraints on variation for the variable consonant cluster reduction among non-native speakers. And report cases of weak transfer, strong transfer, or calquing in replicating target variation patterns on consonant-cluster reduction.

4. Results and discussion

4.1 Wellingtonian English

Table (1) presents the output from the Rbrul regression analysis for the native speakers of Wellingtonian English. The application value for this regression is instances of deleted final stops. The Rbrul output rank orders the statistically significant constraints on consonant cluster reduction from the strongest to the weakest in predicting the variable outcome. This effect is presented by the value named "range". The output also shows the internal hierarchies for these constraints arranged from the levels most likely to be deleted to the least likely to. Non-statistically significant constraints are presented at the end of the table in square brackets.

The results show a deletion rate of 32%. This rate conforms with earlier studies on the same variable in New Zealand and Australian Englishes (Bell 1977; Holmes and Bell 1994). As well as with Pan-American and adult and child varieties of English (Guy 1980; Neu 1980; Labov 1989; Guy 1991; Roberts 1994). The Rbrul output also suggests that three linguistic constraints determine consonant cluster reduction in Wellingtonian English: the following phonological context, the preceding phonological context, and the grammatical category of a token, respectively. The results also suggest that neither age nor gender significantly affect consonant cluster reduction in Wellingtonian English.

The Rbrul output shows that the following segment constraint displays the strongest effect on consonant-cluster reduction. This is also true in all native varieties of English (Bell 1977; Holmes and Bell 1994; Guy 1980; Neu 1980; Labov 1989; Guy 1991; Roberts 1994; Tagliamonte and Temple 2005; Smith et al. 2009;

Hoffman and Walker 2010). This result is unsurprising, especially if we consider the idea of re-syllabification, whereby one is more likely to keep a final consonant stop if it forms a plausible syllable with the following sound. A look at the internal hierarchy of this constraint, presented in Table (1), supports this explanation. A final (t,d) is more likely to be deleted if followed by another stop. Whereas a following vowel presents a chance to create a new syllable structure, and therefore, the final stop is maintained (cf. Guy 1980; Labov 1997).

The findings about the role of the preceding phonological context are unexpected for two reasons. The first is that it usually has a weak, if any, effect, as reported in the literature. Secondly, the strength of effect it displays, introduced by the value called "range," shows that this constraint is almost as strong as the following segment constraint for the native-speaker sample. Table (1) shows that the following phonological context has an effect size of (40), and the preceding segment phonological context constraint has an effect size of (38). The same reasoning of resyllabification may apply here, but other phonological rules are also used to ease articulation. The internal hierarchy of Wellingtonian English is compatible with Philadelphian English (Labov 1997), again suggesting that the effect a constraint has may be subject to dialectal differences.

Grammatical conditioning is also a reoccurring constraint on consonant-cluster reduction in native varieties of English. The usual pattern is that less deletion is likely if a token's meaning or function is at stake. For example, regular past tenses are less likely to receive final consonant cluster reductions because the tense marking affects the grammaticality of a sentence and may also cause ambiguity. Nevertheless, a cross-tabulation between the grammatical category and the following segment illustrated that all grammatical categories favour deletion when the subsequent segment is a consonant (64% of the time). Even past tense categories, which usually disfavour deletion, favour deletion when a consonant follows the word. Irregular and regular past categories favour deletion at 63% and 73%, respectively. Therefore, the deletion rates reported here are associated with articulatory constraints, and grammatical conditioning does not have a genuine effect. The uneven distribution of the data in my sample clouded the results. In conclusion, the role of grammatical constraints on consonant cluster reduction seems to be dialect-specific. Some native varieties of English do not have grammatical conditioning as a statistically significant constraint on variation like New Zealand English and contemporary British varieties (Tagliamonte and Temple 2005).

Table 1. Rbrul output for constraints on consonant-cluster reduction in Wellingtonian English (Deletion rate 32%)

Constraints on consonant-cluster-reduction	Log odds	No. of tokens	The proportion of application value (%)	Centered input probability
Following segment				
Stops	0.79	55	46	0.69
Non-sibilant-fricatives	0.32	73	34	0.58
Glides	0.27	48	33	0.57
Nasals	0.16	39	39	0.54
Sibilant-fricative	0.14	66	36	0.54
Vowel	-0.79	264	32	0.31
Pause	-0.89	101	19	0.29
				Range = 40
Preceding segment				
Nasals	1.1	334	46	0.75
/l/	-0.18	161	21	0.46
Stops	-0.38	94	18	0.41
Fricatives (sibilant and non-sibilant)	-0.54	57	11	0.37
				Range = 38
Grammatical category				
Nouns and base-form-verbs	0.54	361	39	0.63
Adjectives	0.09	138	32	0.52
Irregular-past-and-regular past	-0.63	147	18	0.35
				Range = 28
Speaker random	Standard deviation = 0.87			
Word random	Standard deviation = 0.94			
Statistically non-significant constraints [gender, age]				

The social constraints tested in this paper are non-statistically significant for native speakers. Nevertheless, the behaviour of these constraints is in the expected direction as in other native speaker varieties. Women and middle-aged people are the least likely to delete final consonant stops. Based on the results, I propose that New Zealand English, as presented by the Wellington sample, shares similar underlying grammar with other native varieties of English. However, the rank order, the internal hierarchies and the strengths of effects of these constraints are dialect-specific and set Wellington English apart from other varieties of native English.

4.2 The non-native English sample

Table (2) presents the output from the Rbrul regression analysis for the non-native speakers' sample. The application value for this regression is instances of deleted final stops. The Rbrul output rank orders the statistically significant constraints on consonant cluster reduction from the strongest to the weakest in predicting the variable outcome. This effect is presented by the value named "range". The output also shows the internal hierarchies for these constraints arranged from the levels most likely to be deleted to the least likely to. Non-statistically significant constraints are presented at the end of the table in square brackets.

The results show a deletion rate of 28%. This rate is close to the target native Wellingtonian English reported earlier and is also in tandem with older results for the same variable in New Zealand and Australian Englishes (Bell 1977; Holmes and Bell 1994). This suggests that this non-native sample is attentive to dialect-specific aspects of variation in the target language. The Rbrul output also indicates that two linguistic constraints mainly determine consonant cluster reduction in their non-native speech: the following and preceding phonological contexts. Grammatical conditioning is not a significant constraint on variation for the group, as are age and gender.

The Rbrul output shows that the following segment constraint displays the strongest effect on consonant-cluster reduction. Once more, this constraint has been reported to have the strongest impact on consonant cluster reduction in native and contact-induced varieties of English. Nevertheless, the strength of effect reported for this constraint among the non-native sample is weaker than that reported for the native Wellingtonians (27 Vs. 40).

Although the internal hierarchy reported for this group diverges slightly from that of the target Wellingtonian variety. The non-natives have acquired the main distinction between following vowels and pauses on the one hand and following consonants on the other. And the mild discrepancy observed here can be explained by considering first language transfer effects. As suggested earlier, following pauses and vowels present room for resyllabification. Specifically, maintaining or dropping a word's final stop is subject to whether or not it may form a plausible syllable structure with a following sound in the native language of the sample. Arabic allows initial /tk/ and /tl/ clusters, unlike English. Arab migrants might be less likely to delete the final consonant with the following /k/ and /l/ because they can form plausible clusters in Arabic.

The Rbrul output also shows that the preceding phonological context has the second strongest effect on consonant cluster reduction in non-native speech. This strength of effect, however, is much lower than that of the native target variety (20 Vs. 38). The internal hierarchy also diverges slightly from that of the native target. Still, the non-natives acquire the main distinctions found in native speech. Word final stops are more likely to be deleted after nasals in clusters like /nt, nd/, probably

because nasals and alveolar stops /t,d/ share the same place of articulation, so one sound is deleted for ease of articulation. Preceding stops, like with native speakers of Wellingtonian English, favours retention, but liquids seem to pause a challenge for the non-native sample. Again, this can be explained as a first language transfer effect. Wellingtonian English is non-rhotic, whereas rhoticity is not a phonological aspect of Arabic phonology. Therefore, non-natives treat liquids (/r/ and /l/) similarly because Arabic allows /rt, rd, lt, ld/ consonant clusters.

The grammatical category constraint is not statistically significant for non-native speakers. This illustrates that the non-native sample is sensitive to dialectal differences because I have already proven that grammatical conditioning is not significant in Wellingtonian English. Age and gender are also not statistically significant for the non-native group.

Table 2. Rbrul output for constraints on consonant-cluster reduction in the non-native sample (Deletion rate 28%)

Constraints on consonant-cluster-reduction	Log odds	No. of tokens	Proportion of application value (%)	Cantered input probability
Following segment				
Nasals	0.56	32	38	0.64
Fricative and non-sibilant-fricatives	0.49 - 0.15 -	587 187	36 23	0.62 0.46
Glides	0.36 -	505	22	0.41
Vowels pauses	0.54	293	21	0.37 Range= 27
Preceding segment				
Nasals	0.84	65	40	0.70
Sibilant and non-sibilant-fricatives	0.45	345	39	0.61
Stops	0.075	172	31	0.52
Liquids	-0.003	75	29	0.50 Range = 20
Speaker random Standard deviation = 0.87 Word random Standard deviation = 0.86 [gender, age, grammatical category]				

4.3 Variation in non-native speech

To identify and quantify the change imposed on the target constraints on consonant cluster reduction by the non-native sample, I have mapped the findings from the regression analysis onto the "transformation under transfer" typology. The patterns I found best match cases of strong transfer and calquing. These are summarised below:

1. Strong transfer of the target variety's frequency of occurrence of the variable consonant cluster reduction, i.e., 28%.
2. Calquing of the target variety's following segment constraint. The non-native sample has exactly replicated this constraint's rank order and maintained a native-like internal hierarchy. The only deviation from the target norms is a smaller effect size.
3. Strong Transfer of the target variety's preceding segment constraint. The non-native sample has replicated the rank order of this constraint, only slightly deviating from replicating the target internal hierarchy due to first language transfer. This constraint also displays a smaller effect size compared to the target variety.
4. The non-native sample has also picked up on social cues. Therefore, the social constraints found non-significant in the target variety were non-statistically significant among the non-native sample.

The reported results are surprising, especially for first- and second-generation migrants with low proficiency in a second language who would be expected to illustrate strong first-language transfer effects. What adds to the peculiarity of these results is that they were replicated, for the same variable, by other non-native groups who shared similar contact setting experiences. Non-native groups with different first languages could strongly replicate target articulatory constraints on the variable consonant-cluster reduction. Like Arab migrants who added a sound to the end of words, Italian migrants to Canada applied paragoge on target words (Hoffman and Walker 2010). Moreover, Chinese migrants learning English in the United States (Bayley 1996), Chinese and Italian first-generation migrants to Canada (Hoffman and Walker 2010), and Mandarin speakers learning English (Guo and Wang 2010; Edwards 2011; Edwards 2016) display the following segment as having the strongest effect on consonant-cluster reduction. The role of the preceding phonological context has also been reported to have a strong effect among first-generation Mandarin native speakers who deleted more coronal stops syllable-finally if it was preceded by an /n/. These non-native groups tried to form acceptable singleton codas allowable in their first languages (cf. Bailey 1996; Hoffman and Walker 2010; Edwards 2011).

An obvious explanation for these results may be that articulatory constraints, like the following phonological context and the preceding phonological context, have a universal aspect that allows non-native speakers to notice and acquire them. This universal aspect may be related to sonority because phonological constraints are more salient. Another line of reasoning inspired by Labov (1989) suggests that non-native speakers, like child native speakers, are inclined to follow a universal

order of acquisition of constraints on variation. First, they acquire articulatory constraints, then grammatical constraints, and finally, social constraints (see also Edwards 2011). This would explain why non-native groups with low proficiency in a second language would display instances of calquing and strong transfer of target constraints on variation regardless of their low proficiency in English as a second language.

5. Conclusion

One of the study's implications is that target constraints on consonant-cluster reduction may be categorized into language-specific and dialect-specific, and this typology may be applied to study native speaker constraints on other variables. This would create uniformity in the study of language variation and change in native and non-native speech. It also renders the study of non-native patterns of variation achievable and replicable, even in the case of variables undergoing change. Another important implication of this paper is that the complexity of target norms, in terms of constraint type (articulatory, grammatical, and stylistic) and the linguistic levels involved (phonological, morphosyntactic, semantic), do not prevent non-native speakers from acquiring them. What matters is the non-native speaker's experience in a contact setting. Non-native speakers readily acquire articulatory constraints regardless of the first language or proficiency in the target variety. Therefore, more research is needed to evaluate this hypothesis, considering a range of potential operationalizations of sonority and salience. Are articulatory constraints more sonorant because they are audible, i.e., migrants can hear them? Or is it an issue of noticing social meaning and stigma? Further research is needed to investigate if articulatory constraints are more likely to host first language transfer and ethnic marking than other constraint types.

The implications are promising and may be further developed to help researchers understand the interaction between social factors, contact experiences, and linguistic universals and how they collectively impact variation in non-native speech.

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