Sociophonetic Markers Facilitate Translation Priming: Māori English GOAT – A Different Kind of Animal

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1 Introduction

The organizational structure of bilinguals' linguistic knowledge is a key question in bilingualism research. Research in the last several decades has concentrated on examining whether bilinguals have one shared mental lexicon or two separate lexicons. The evidence tends in favor of the hypothesis that a bilingual's two languages are distinct at the lexical level, but share a single conceptual level. The most influential model of bilingual lexical representation and processing is currently the *Revised Hierarchical Model* (Kroll and Stewart 1994), which assumes direct links between the L1 and L2 lexicons and the shared conceptual level. It also makes assumptions about the strength and directionality of these links. The link between the conceptual level and the L1 lexicon is argued to be stronger than that between the conceptual level and the L2 lexicon. In terms of the lexicon, however, the L2 lexicon is more tightly connected to the L1 lexicon than the L1 lexicon is to the L2 lexicon; that is, the strength of the link between the two lexicons is asymmetric.

While work on monolingual populations has demonstrated that social information influences speech perception (e.g., Niedzielski 1999, Hay et al. 2006, Drager 2011), the ways in which social information might be shared across the two languages of a bilingual has not been investigated. This paper examines whether socio-indexical labeling operates under a *shared* or a *separate* system across the two languages for bilingual talker-listeners. We argue for a shared system, showing that L1 indexical labels interact with L2 indexical labels during speech perception. In particular, the study examines the role of *ethnic dialect* on bilingual language processing. Figure 1 shows the hypothesized operation of socio-indexical labeling, where labels across the L1 and L2 lexicons interact with each other. This direct link is indicated as the red arrow in the figure. The blue arrows show the conceptual and lexical links suggested by the *Revised Hierarchical Model* (Kroll and Stewart 1994); weaker links are shown as dashed lines, and stronger links as solid lines.

The present study assumes a hybrid, dual-processing model of speech perception, where both abstract and episodic representations are mentally represented (e.g., McLennan et al. 2003, Luce et al. 2003, Sumner and Samuel 2009). Abstractionist-only theories assume a mental lexicon with abstract canonical representations, where variability in speech—such as, for example, socially conditioned phonetic information—is treated as some kind of noise (e.g., Posner 1964, Morton 1969, Jackson and Morton 1984, Norris 1994). Under these models, the surface noise is filtered out by a normalization process prior to accessing an abstract underlying representation. Abstractionist frameworks are thus generally unable to provide an account for how sociophonetic variability is attended to (however, see e.g., Cutler et al. 2010 for an abstractionist view on speaker-related variation, where retunement of phonemic categories is a necessary part of lexical access). On the other end of the spectrum, episodic theories argue that word representations are composed of detailed memory traces of auditory experiences (e.g., Goldinger 1996). Exemplar-based theories propose that phonetically detailed memories of utterances are represented together with socially indexed information (e.g., Johnson 1997, Pierrehumbert 2001). Episodic-only theories do not assume an abstract, underlying representation. There is growing evidence in support of the idea that a mixed-representation, dual-processing model of speech perception is preferred over abstract-only or episodic-only models (e.g., McLennan et al. 2003, Luce et al. 2003, Sumner and Samuel 2009). Such a model assumes that both abstract and specific representations are present, and suggests that both abstract and episodic codes cooperate in spoken word recognition.

Sumner and Samuel (2009) investigated what role these two types of representations play in cross-dialect variant processing for groups of listeners who have different levels of familiarity with a dialect. The authors were interested in resolving whether dialect variants are processed as variants of a single abstract representation, or whether dialect variants are stored as individual representations

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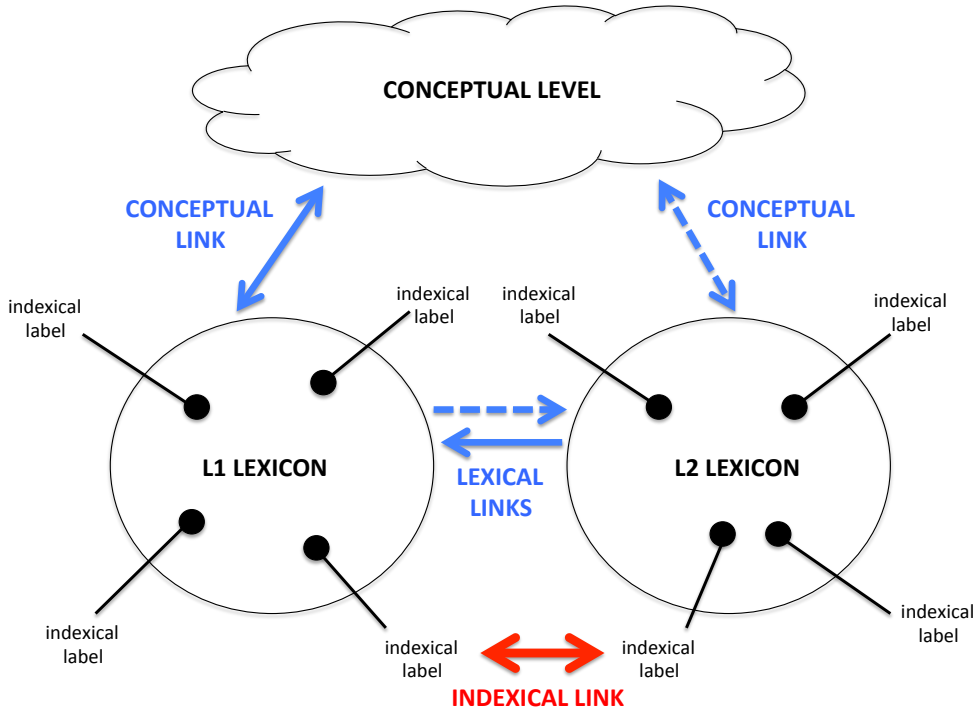

Figure 1: Hypothesized operation of bilingual socio-indexical labeling. Labels across L1 and L2 are able to activate and interact with each other. The red arrow indicates the direct link between indexical labels, while the blue arrows show the conceptual and lexical links suggested by the *Revised Hierarchical Model* (Kroll and Stewart 1994).

for speakers. They also tested whether this is dependent on language background. In a series of experiments Sumner and Samuel (2009) examined the processing and mental representation of non-rhotic New York City (NYC) and rhotic General American (GA) dialect variants, and the effect that prior experience with the dialects might have on spoken word recognition. In particular, they looked at *-er* final words, such as NYC [beɪkə] versus GA [beɪkɚ]. In their first experiment a short-term form priming was used, which is a paradigm used to examine the effects of surface features on immediate speech processing. Listeners are presented with a prime followed by a phonologically related target and asked to make a lexical decision to the second item of each pair. This experiment was designed to test if *r-less* forms are as effective as *r-ful* forms in priming an identical word. The authors created four conditions: (1) GA prime [beɪkɚ] and GA target [beɪkɚ]; (2) NYC prime [beɪkə] and GA target [beɪkɚ]; (3) GA prime [beɪkɚ] and NYC target [beɪkə]; (4) NYC prime [beɪkə] and NYC target [beɪkə]. Three different participant groups were used: the GA group with little prior exposure to the NYC dialect, and two NYC groups based on their own speech production: an r-less Overt-NYC group and an r-ful Covert NYC group. The results of this first experiment revealed that there was no priming effect for GA subjects when presented with the NYC prime. That is, for these participants [beɪkə] does not facilitate the processing of [beɪkɚ] or [beɪkə]. However, for the two NYC groups both r-ful and r-less variants acted as successful primes. These results suggest that listeners who have experience with both dialects (i.e., the two NYC groups) are more flexible in form processing and they show greater perceptual adaptability. In another experiment Sumner and Samuel (2009) used a long-term priming paradigm, which gives insight into the structure of abstract mental representations, rather than just immediate form processing. In this experiment the stimuli were presented in two blocks, where the time between a prime and its target was around

20–30 minutes. The results in this case revealed a significant difference between the Overt-NYC and Covert-NYC participants. Overt-NYC participants appear to store both r-ful and r-less forms at the abstract phonological level, whereas the Covert-NYC group only encodes the r-ful form as the underlying representation.

Primed lexical decision tasks, such as the ones used by Sumner and Samuel (2009) have also been applied within the field of bilingualism to investigate how information crosses from one language to the other. In the bilingual priming paradigm the prime and target are taken from the two different languages of the bilingual speaker. For example, if an English-French bilingual hears the word *girl* in English, then hears the translation equivalent in French, she will be faster at processing *fille*, the French translation equivalent, than if she had not heard the English translation first. This phenomenon is referred to as translation priming. To measure how much processing is facilitated by being exposed to the translation equivalent, researchers can rely on the auditory lexical decision task. Participants hear pairs of words over headphones, and they have to decide whether the second word in a sequence (= target) is a real word or a non-word. By measuring their *reaction times*, we can investigate how much faster the translation equivalents are being processed in comparison with the unrelated items, which are used as a baseline control. The Spanish-English translation pair *perro* and *dog*, for example, is processed faster than the unrelated pair *cerveza* (= BEER) and *dog*.[1] The difference between the reaction time for translation pairs and unrelated pairs is called the *priming value*.

An important feature of this phenomenon is the apparent asymmetry in translation priming. Bilingual priming experiments consistently show significant priming when the prime word is in the L1 and the target word is in the L2. However, results are less consistent when the prime is in the L2 and the target is the L1. Some studies have found significant priming (Basnight-Brown and Altarriba 2007, Duñabeitia, Perea, and Carreiras 2010, Duyck and Warlop 2009, Schoonbaert, Duyck, Brysbaert, and Hartsuiker 2009), some only borderline significance or no priming at all (Gollan, Forster, and Frost 1997, Finkbeiner, Forster, Nicol, and Nakamura 2004, Jiang and Forster 2001). This is normally explained by a weaker link between the L2 lexicon and the conceptual level, and a stronger link between the L1 lexicon and the conceptual level within the *Revised Hierarchical Model* (Kroll and Stewart 1994). This priming asymmetry is revisited in Section 3.

As mentioned above, dialect can have an effect on monolingual speech processing and representation (Sumner and Samuel 2009), however, it is not known whether it can also affect bilingual speech processing and representation. To investigate this question, we extended the cross-dialect priming paradigm of Sumner and Samuel (2009) to a cross-dialect/cross-language paradigm by adding a bilingual component to it. In such a paradigm critical prime and target pairs are made up of L1 and L2 translation equivalents, where the L1 forms themselves have two different dialect variants. New Zealand is an ideal place to run an experiment like this, as the official languages include English and Te Reo Māori (= The Māori Language) (TR), where New Zealand English itself has two main ethnic dialects,[2] namely Māori English (ME) and Pākehā English (PE). ME is predominantly spoken by the indigenous Māori population, while PE is mainly spoken by people of European descent. The differences between the two ethnic dialects include both segmental and suprasegmental features. Differences generally mentioned in the literature include higher ME proportions of θ-fronting, final z-devoicing, GOOSE-fronting (Bell 2000), and a more monophthongal GOAT with a fronted onset (e.g., Maclagan, King, and Szakay 2008, Maclagan, Watson, Harlow, King, and Keegan 2009). ME speakers are also significantly more syllable-timed, have a higher mean pitch (Szakay 2006), and a creakier voice quality (Szakay 2012) than PE speakers. English-Māori bilinguals are exposed to both ethnic dialects of New Zealand English. This provides an ideal testing ground for the effect of dialect variants on bilingual speech processing and representation.

[1] Unless, of course, one has a dog that particularly enjoys drinking beer, in which case some semantic priming effects are expected to be observed.

[2] Using Benor (2008)'s terminology, these two varieties are better thought of as ethnolinguistic repertoires, rather than two qualitatively different dialects.

2 Methods

As part of our research project two main experiments were run. A short-term auditory lexical decision task investigated the effect of dialect on immediate bilingual speech processing, while a long-term auditory primed lexical decision task investigated the effect of dialect on bilingual abstract mental representations. This paper reports on the short-term experiment only.

2.1 Stimuli

The goal of this experiment was to understand whether bilingual *processing* of L1 and L2 forms is affected by L1 ethnolectal variants. To investigate the potential effect of dialect on bilingual speech processing, a novel cross-language/cross-dialect auditory primed lexical decision paradigm was developed. In this paradigm critical prime and target pairs were made up of English-to-Māori and Māori-to-English translation equivalents. Half of the English words were pronounced by a PE speaker, and half by a ME speaker, thus creating four bilingual test conditions: ME-TR, PE-TR, TR-ME, TR-PE. Four English-only repetition priming conditions were also included: PE-PE and ME-ME (within dialect), and PE-ME and ME-PE (cross-dialect), as well as a within Māori repetition priming condition. This creates a total of nine possible conditions, which are illustrated in Table 1 using the translation pair *thing* and *mea* as an example. A target could be the Māori word /mea/ (THING), with either the Pākehā English prime [θɪŋ], or the *θ*-fronted Māori English prime [fɪŋ]. The present paper reports on the four bilingual conditions only, which are marked as bold in the table.

CONDITION			PRIME	TARGET	EXAMPLE	
TR	–	TR	Māori	Māori	*mea*	*mea*
TR	**–**	**ME**	**Māori**	**Māori English**	***mea***	***fɪŋ***
TR	**–**	**PE**	**Māori**	**Pākehā English**	***mea***	**θɪŋ**
ME	**–**	**TR**	**Māori English**	**Māori**	***fɪŋ***	***mea***
ME	–	ME	Māori English	Māori English	*fɪŋ*	*fɪŋ*
ME	–	PE	Māori English	Pākehā English	*fɪŋ*	*θɪŋ*
PE	**–**	**TR**	**Pākehā English**	**Māori**	**θɪŋ**	***mea***
PE	–	ME	Pākehā English	Māori English	*θɪŋ*	*fɪŋ*
PE	–	PE	Pākehā English	Pākehā English	*θɪŋ*	*θɪŋ*

Table 1: Examples of all combinations of prime and target pairs, illustrated by the English-Māori translation pair *thing* and *mea*. This paper only reports on the four bilingual conditions marked as bold in the table.

Eighty-one critical English-Māori translation pairs were created using the four main segmental variables that distinguish ME and PE: *θ*-fronting, GOOSE-fronting, final-z devoicing and GOAT-fronting and monophthongization. Of these variables, the fronted GOAT vowel is the most recent and innovative variant of ME, which appears to be categorically used by ME speakers only. However, *θ*-fronting, GOOSE-fronting, and final-z devoicing are also used by PE speakers to some extent. To serve as a control in the priming experiment, eighty-one unrelated pairs were also created by randomly re-pairing items from the critical list. Special attention was paid to exclude certain types of items from the list, such as homophones (e.g., *nose – knows*), and items where using the sociophonetic variant would create another existing lexeme (e.g., *thin – fin*, or *phase – face*). English and Māori filler and pseudo-words were also included. For the English filler words we used real words that do not contain any of the four sociophonetic variables. The pseudo-words were created based on the critical and filler words by changing only one phoneme; these forms obeyed the rules of English and Māori phonotactics. Because of the nature of the design, two-thirds of the critical and control pairs were in English (due to the two dialects), and only one-third in Māori. To make up for this difference, proportionately more Māori than English words were used as fillers, to give the overall 50% English and Māori ratio.

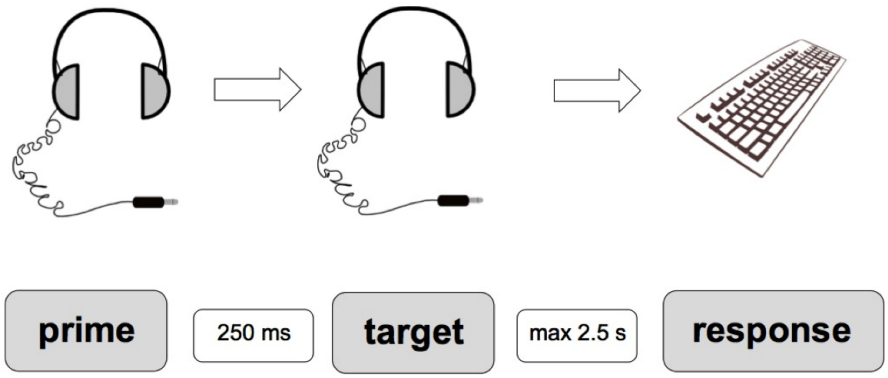

Figure 2: Experimental procedure for the short-term auditory primed lexical decision task.

2.2 Design

To make sure that no target is primed by more than one item, it was crucial that no words, variants of a word, or translation equivalents of a word were repeated for any participant. This means that if, for example, a participant hears the critical pair *θɪŋ (PE) – mea (TR)*, the same participant will not hear the *θ*-fronted ME variant *fɪŋ*, either as part of a critical pair or a control pair. Similarly, if another participant hears the critical pair *θɪŋ (PE) – fɪŋ (ME)*, he or she will not hear the Māori translation equivalent *mea* as part of another critical or control pair. In order to achieve this, nine separate counterbalanced lists were created. Each list includes 45 critical pairs, 36 control pairs, 99 filler pairs, and 180 pseudo-target pairs, resulting in a total of 360 pairs. This way the real word / pseudo word ratio is 50%, while the relatedness proportion is a sufficiently low 30%. Every prime word was produced by a female speaker, while all target words were pronounced by male speakers. Thus, altogether 6 speakers were recorded for the stimulus material: one female ME speaker, one female PE speaker, one female TR speaker, and three corresponding male speakers. In auditory priming studies it is customary for the prime and target to be produced by speakers of different genders to ensure that any potential priming effect is not due to mere voice repetition effects.

2.3 Participants

Fifty-four English (L1) – Māori (L2) bilinguals participated in the short-term auditory lexical decision task. No participant reported any hearing impairment. All listeners were English language dominant, who self-reportedly use the Māori language between 5–40% in their every day life. Twenty-six females and 28 males participated, with an age range of 18–40. All subjects came from the South Island of New Zealand, were recruited by the snowball method, and all received monetary compensation for their participation.

2.4 Procedure

The experiment was run using the E-Prime psycholinguistics software (Schneider, Eschman, and Zuccolotto 2007) on a portable laptop. All participants were individually tested in a quiet room, and prime and target pairs were presented over headphones. Participants first heard the prime word spoken by a female, then after a 250ms inter-stimulus interval (ISI) they heard the target word spoken by a male. Their task was to decide whether the target word pronounced by the male speaker was a real word or a non-word. Participants had 2.5 seconds available to make a lexical decision on the target word. Figure 2 provides a visual representation of the experimental procedure.

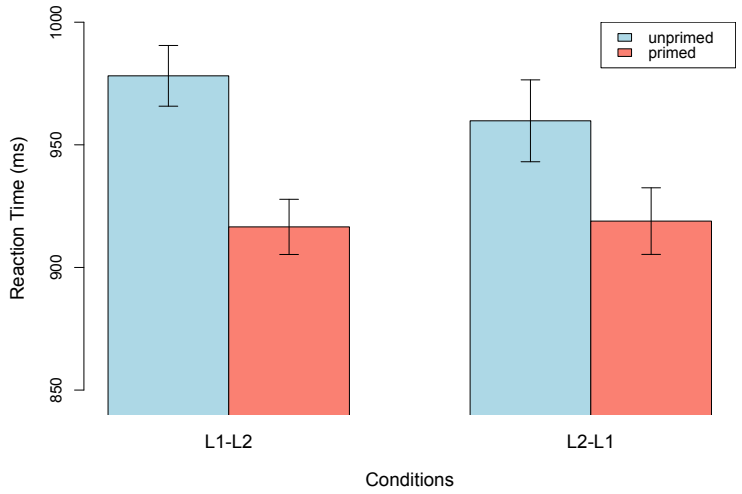

Figure 3: Mean reaction times and SE values are shown for the combined L1-L2 conditions, and the combined L2-L1 conditions.

Subjects were told that they would hear several different speakers and that the words could be either in English or in Māori. They were, however, not informed that half of the English words would be in Māori English while the other half in Pākehā English. They were asked to respond as fast and as accurately as possible. As feedback, their reaction time was displayed on the screen after each trial, however their accuracy was not revealed to them. The next trial started 1.5 seconds after the lexical decision was made. The total duration of the experiment lasted around 35 minutes, with an optional break in the middle, after the first 180 trials. Participants were required to fill out an anonymous background information sheet after the experiment.

2.5 Analysis

Due to the nature of the design—that is, ensuring that no participant hears any item, variant, or the translation equivalent twice—it is not possible to compute priming values for each target within an individual participant. Rather, an across-subject analysis is needed. To establish whether significant priming was achieved, reaction times to critical and control pairs were compared using non-paired two-sampled t-tests for each condition. Outliers over 2.5 SD away from the mean were removed to obtain a normal distribution of RTs. Only accurate lexical decision responses were included in the statistical analysis.

3 Results

Overall the results reveal significant translation priming from L1 to L2 when the Māori English and Pākehā English collapsed data are included in the analysis ($t(761.28) = 4.96$, $p < .001$). This is an expected result based on previous research within the field of bilingualism, where studies consistently find significant translation priming when the prime is in the L1 and the target is in the L2. Our results also show significant priming from L2 to L1 ($t(740.06) = 2.71$, $p < .01$). This also fits in with previous results in the bilingualism literature, where L2-L1 priming occurs much less consistently than L1-L2 priming. When it does occur, the magnitude of the effect is much smaller than the L1-L2 priming effect (Basnight-Brown and Altarriba 2007, Duñabeitia, Perea, and Carreiras 2010, Duyck and Warlop 2009, Schoonbaert, Duyck, Brysbaert, and Hartsuiker 2009). Figure 3 shows RTs for the overall L1-L2 and L2-L1 conditions for primed and unprimed pairs. Priming is

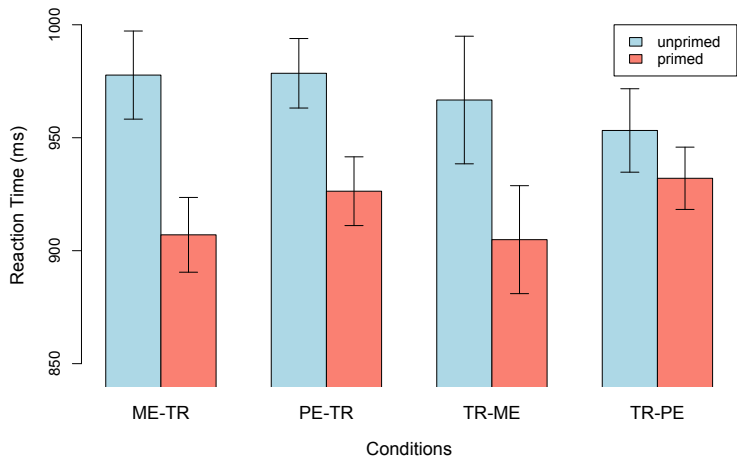

Figure 4: Mean reaction times and SE values are shown by dialect for each cross-language condition.

the difference between the mean reaction time for unrelated control pairs and mean reaction time for critical translation pairs. These results are reassuring in that they replicate previous findings, however, they gloss over potential differences in how the two L1 varieties prime L2.

Closer analysis reveals that the English (L1) – Māori (L2) significant priming effect is mainly carried by the Māori English primes. Figure 4 demonstrates RTs for primed and unprimed pairs in the four bilingual priming conditions, and shows a significant effect of dialect. The mean priming effect in the ME-TR condition is 85ms, which is statistically significant (t(360.83) = -3.96, $p < .001$). The PE-TR condition also shows a significant effect (t(400.79) = -3.01, $p < .01$), with a mean priming value of 54ms. However, the ME-TR condition has a medium effect size (Cohen's d = -0.41), while the PE-TR condition has a very small effect size (Cohen's d = -0.14). In other words, a Māori English word primes its Māori translation equivalent better than a Pākehā English word primes its Māori translation equivalent. Looking at the L2-L1 conditions in Figure 4, we see significant translation priming in the TR-ME condition (t(367.47) = -2.77, $p < .01$), but not in the TR-PE condition (t(336.81) = -0.91, $p = .35$). Taken together, these results suggest that there is a stronger connection between Māori and Māori English than between Māori and Pākehā English.

Recall from Section 2.1 that four different New Zealand English sociophonetic markers were used when creating the critical pairs for the stimulus. The status of these four variables is not equal. The GOAT variable shows the biggest difference between Māori English and Pākehā English, as this is the most recent and most innovative variable, almost categorically used by Māori English speakers only. The use of θ-fronting, final-z devoicing and to some extent GOOSE-fronting has already spread to Pākehā English as well, thus the differences between the two ethnic dialects are quantitative rather than qualitative with regard to these three variables. Figure 5 shows priming values by the four target variables in the TR-ME condition, where the prime is in Māori and the lexical decision needs to be made on the following Māori English target. As the graph shows, the biggest priming value is observed for prime-target pairs where the target contains the GOAT variable (t(80.58) = 3.51, $p < .001$). Targets that contain the fronted ME GOOSE vowel do not quite reach statistical significance (t(70.37) = 1.76, $p = .08$).

4 Discussion

A novel cross-language/cross-dialect priming paradigm was created to investigate the potential effect of dialect on bilingual language processing and representation. A short-term auditory primed lexical decision experiment demonstrated clear dialect-based differences in the immediate perceptual

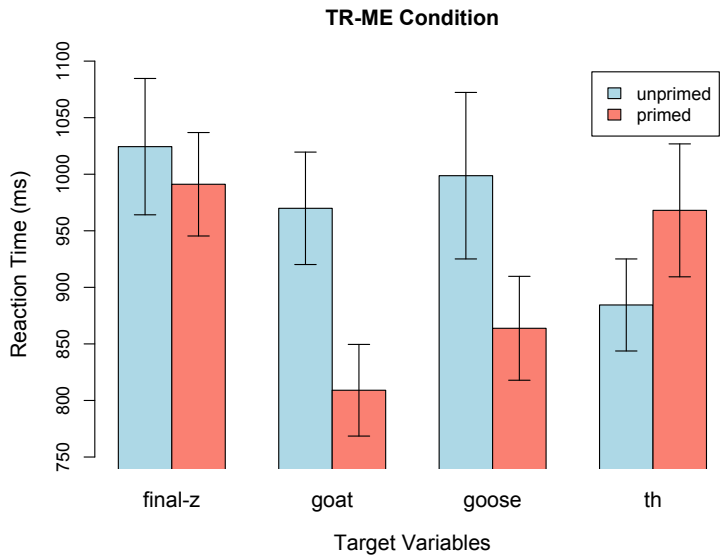

Figure 5: Mean reaction times and SE values are shown for each sociophonetic target variable in the TR-ME condition.

processing of bilingual speech. Evidenced by larger and more significant priming values, the results of this study reveal a stronger connection between Māori and Māori English translation equivalents than between Māori and Pākehā English translation pairs. As a possible explanation, we argue that both the Māori and the Māori English translation equivalents are indexed with some kind of *Māoriness* label, while the Pākehā English words are indexed with the label *Pākehā*. The larger priming effects found between Māori and the Māori English compared to Māori and Pākehā English suggest a direct activation link between the *Māori* indexical labels within the English language set of representations and the *Māori* indexical labels within the Māori language set of representations. This suggests that socio-indexical labelling operates under a *shared* system across the two languages of a bilingual speaker, and that indexical labels can activate and interact with each other across L1 and L2. Figure 6 shows a schematic representation of this process. Being exposed to the Māori word *huka* (=SNOW) activates not only other Māori words but also words within the English set of representations that are labelled with *Māori*, because they were likely uttered by a Māori English speaker. This activation link is bidirectional, as evidenced by the facilitation of translation priming by sociophonetic markers in both the ME-TR and TR-ME conditions.

The results also revealed that of the four sociophonetic markers, the GOAT vowel exhibits the largest priming value. This suggests that the indexical labels attached to incoming items during speech perception have differing weights. As the most innovative and almost categorically Māori English form, the fronted and monophthongized GOAT receives the heaviest Māori label, as it almost certainly pronounced by a Māori English speaker. In contrast, the use of final-z devoicing is only quantitatively different between Māori English and Pākehā English, hence it does not receive a very heavy *Māori* label. Those variants that have a heavy indexical label, and thus are weighted more highly, become activated the fastest, even across L1 and L2. This explanation can account for the fact that we see the biggest priming facilitation between ME and TR with words that contain the GOAT vowel.

5 Conclusion

This study demonstrated that socio-indexical labeling operates under a shared, interactive system across the two languages of a bilingual talker-listener, by showing that L1 indexical labels can acti-

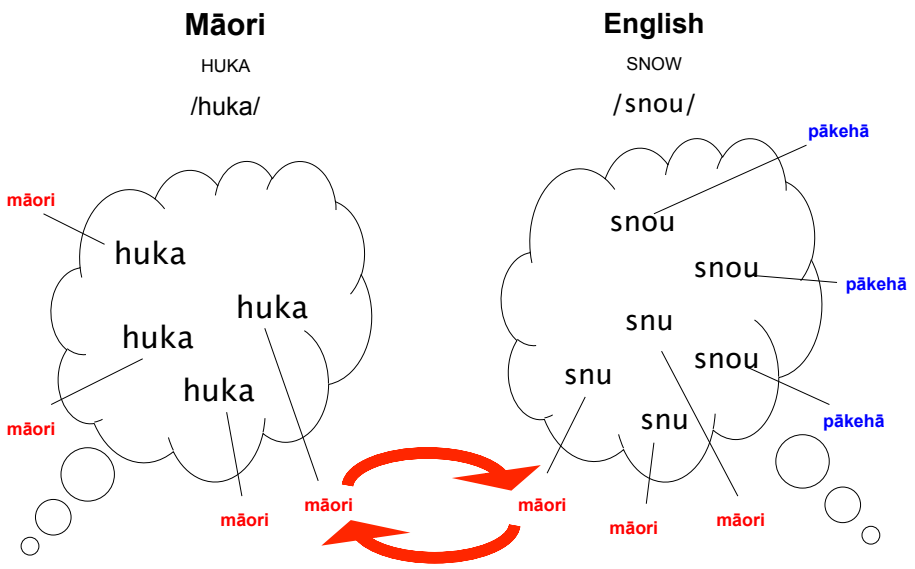

Figure 6: Socio-indexical labelling operates under a shared system across the two languages of a bilingual speaker. Labels can activate and interact with each other across the L1 and L2 lexicons in both directions.

vate L2 indexical labels, and vice versa. The results suggest that socio-indexical labels can facilitate translation priming. In particular, recent, more innovative variants appear to be processed as special in short-term memory. Using a long-term priming paradigm as a follow-up study, we are now investigating how these dialectal variants are stored in the bilingual mind at a more abstract level. The study will also aim to establish whether innovative sociophonetic variants are also encoded and stored as special in long-term memory, or are only ever processed as special in short-term memory.

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