# The Effect of Dialect on Bilingual Lexical Processing and Representation

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# Abstract

Psycholinguistic studies on bilingualism generally investigate how linguistic information is shared between a listener's first language (L1) and second language (L2) at the conceptual level and in the lexicon. At the same time speech perception studies examine how social information affects language processing and representation. This dissertation brings these two lines of research together and demonstrates that the L1 and L2 are connected through a *social category activation link*, in addition to previously proposed conceptual and lexical links. In particular, I show that the activation of *ethnicity* operates under a shared system across the L1 and L2 during both immediate speech processing and long-term abstract representations. This claim is supported by sensitivity and reaction time results from two priming experiments.

In a novel cross-language / cross-dialect paradigm, English (L1) – Māori (L2) bilingual New Zealanders participated in a short-term and a long-term auditory lexical decision task (72 and 45 subjects respectively), where critical prime and target pairs were made up of English-to-Māori and Māori-to-English translation equivalents. Half of the English target words were pronounced by standard New Zealand Pākehā English speakers and half by Māori English speakers, thus creating nine test conditions: four bilingual conditions, four English-only conditions, and a within-Māori repetition priming condition. Each critical English word contained one of four sociophonetic variables: /θ/, final /z/, and the GOOSE or GOAT vowels.

The results reveal a stronger connection between Māori and Māori English representations than between Māori and Pākehā English representations both in short-term processing and long-term mental representations. I argue for the existence of an ethnicity activation link between the L1 and

L2. The strength of this link varies based on the directionality and time-course of activation, the sociophonetic variable in the word, and the listeners previous experience with the social category.

# Preface

- The experiments in this dissertation were run under approval of the University of British Columbia Behavioural Research Ethics Board (certificate no. H10-0301) in Canada, and the University of Canterbury Human Ethics Committee (certificate no. 2011/27) in New Zealand.

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# Chapter 1

# Introduction

Psycholinguists in the last few decades have taken an interest in the nature of the relationship between first and second language knowledge. This line of research has been particularly interested in how information is shared between a bilingual's first language (L1) and second language (L2) at the conceptual level and at the lexical level. The main questions that have been central to research in this field include whether bilingual speakers have two separate lexicons - one for each language -, or one large shared lexicon, and whether bilingual lexical access is language selective, or language non-selective (e.g., Kroll and Stewart, 1994; Jiang and Forster, 2001; Dijkstra and Van Heuven, 2002; Basnight-Brown and Altarriba, 2007). This research focus, along with the nearly standard use of visual tasks and orthographically presented stimulus material means that phonetic variation has been ignored in the psycholinguistic study of bilingual representations.

Within the field of phonetics it is a long standing idea that speech is perceived in context (Ladefoged and Broadbent, 1957). The field of sociolinguistics had traditionally been concerned with variation in speech production (e.g., Labov, 1972), but social information present in the speech signal has also been shown to affect speech perception (e.g., Strand, 1999; Niedzielski, 1999; Johnson et al., 1999). Socio-indexical features are those aspects of linguistic structure that correlate with non-linguistic factors, such as speaker differences in gender, age, socio-economic status, ethnicity, group affiliations, regional background, and individual identity (Abercrombie, 1967).

This dissertation is interdisciplinary in nature, as its interests lie between the fields of bilingual psycholinguistics and sociophonetics. I examine how social information is represented across speech varieties, and in particular, how social information is shared across the two languages of a bilingual listener. This is done by investigating the effect of ethnic dialect on immediate, short-term bilingual language processing on the one hand, and long-term bilingual representation on the other. One focus of my investigation is how innovative phonetic variables are processed in short-term memory and represented in long-term memory. The study reports on a set of experiments which use naturally produced utterances in an auditory primed lexical decision task, which allows us to examine the role of sociophonetic variation in priming across the L1 and L2 lexicons. The language varieties used in this study are Māori, which is the indigenous Polynesian language of New Zealand, as well as two ethnic varieties of New Zealand English, namely the standard Pākehā English variety and the non-standard Māori English variety, mainly spoken by the indigenous population. An important and exciting aspect of this study is the use of a non-Indo-European language, which are generally underrepresented in experimental linguistic research.

The study extends the Sumner and Samuel (2009) cross-dialect priming paradigm (which will be discussed in detail in Section 1.3.3) to a novel cross-language / cross-dialect paradigm. Independent groups of English (L1) – Māori (L2) bilingual New Zealanders participated in a short-term and a long-term auditory lexical decision task, where critical prime and target pairs were made up of English-to-Māori and Māori-to-English translation equivalents. The English tokens were split amongst the two dominant ethnic dialects of New Zealand; half of the English target words were produced by a speaker of Pākehā English, and half by a speaker of Māori English.

The results reveal a stronger connection between a Māori word and its Māori English translation, than between a Māori word and its Pākehā English translation equivalent. From this evidence I argue that socio-cultural knowledge related to language-specific patterns of use is interconnected with lexical representations. The major findings of this dissertation suggest that:

- the activation of social information operates under a shared system across the L1 and L2;
- the social category activation link between the L1 and L2 can be independent from the lemma activation link;

- both links can range from weak to strong, depending on the direction and temporal properties of activation
- sociophonetic variables can facilitate translation priming in short-term memory;
- the lifespan of social category activation is longer than that of lexical activation

## 1.1 Chapter Overview

The chapter starts with a brief overview of the priming paradigm as an experimental method in Section 1.2.1. This is followed by a description of some influential models of bilingual language representation. Early models are summarized in Section 1.2.2, followed by the description of two highly influential models, the Revised Hierarchical Model (Kroll and Stewart, 1994) in Section 1.2.3, and the BIA+ model (Dijkstra and Van Heuven, 2002) in 1.2.4. Section 1.3 then moves on to review some experimental evidence regarding the effect of social information on speech perception. As part of this discussion I review the study by Sumner and Samuel (2009) on the effect of experience on the perception and representation of dialect variants in Section 1.3.3. A dynamic interactive theory of person construal proposed by Freeman and Ambady (2011) is described in Section 1.3.4. This model provides a framework that can explain social categorization processes at a perceptual level from both visual and auditory cues, and link these processes to higher-order social cognitive phenomena at the same time. Finally, Section 1.4 gives an overview of the Māori language, and the Māori English variety of New Zealand English.

## 1.2 Bilingual Language Processing and Representation

One goal of cross-language priming studies is to determine how bilinguals organize their two languages, whether they store and access word forms and word meanings in their two languages in an independent or an interconnected way. Most of the studies that investigate the nature of bilingual language processing and representation use a priming methodology. The following section provides an overview of this experimental paradigm.

### 1.2.1 The Priming Paradigm

Priming was originally defined as the "facilitative effects of an encounter with a stimulus on subsequent processing of the same or a related stimulus" (Tulvig et al., 1982, p.336). The phenomenon was observed as early as the 19th century by Cattell (1888/1947), who noticed that people can identify a word more quickly if they have recently heard a word with a related meaning. The initial word is referred to as the *prime*, while the subsequent word is called the *target*.

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 the processing of a lexical item is facilitated by being exposed to the translation equivalent, researchers can rely on a variety of experimental procedures, such as lexical decision task, identification task, naming task, fragment completion, or semantic categorization task. In a lexical decision task – which is the one that is used in the present study – participants are exposed to pairs of words and they are instructed to decide whether the second word in a sequence (the target) is a real word or a non-word. By measuring participants' *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*.

The priming paradigm can take many different forms. For example, as mentioned above, we can distinguish between *cross-language* and *within-language* priming. Most L2 studies look at cross-language priming, that is, when participants are exposed to primes in one language and respond to targets in the other language. Within-language priming can occur in the L1 as well as in the L2. Few studies focus on the occurrence of priming in the L2, where both the prime and the target are in the second language (e.g., Trofimovich, 2005). Within-language priming is a type of repetition priming, which investigates participants' implicit sensitivity to repeated word forms. Translation priming, on the other hand, is a type of semantic priming, investigating the extent of semantic activation across the L1 and L2.

A distinction can also be drawn between *visual* and *auditory* priming. The stimulus material can be presented orthographically on a computer screen, or auditorily through headphones. The majority of L2 psycholinguistic studies use a visual task, and only a handful of researchers have used the auditory modality (e.g., Woutersen et al., 1994, 1995; Trofimovich, 2005). Woutersen et al. (1994, 1995) were interested in how bidialectal speakers organize their lexicons, and investigated word processing in bidialectal speakers of standard Dutch and the Maastricht regional dialect of Dutch. They used an auditory lexical decision task to examine within- and across-dialect priming effects using the two varieties. The authors were mainly interested in lexical, and not phonetic, differences between the two dialects. However, they were forced to use an auditory lexical decision task because the two varieties share an orthography. Auditory priming tasks are much more common in L1 studies. This line of research has revealed that it is not only repeated or related words that can be primed, but also their contextual details. Craik and Kirsner (1974) demonstrated that participants were not only faster at responding to repeated items, they were also faster at responding to previously heard, repeated voices. Since then other studies have also shown that contextual details are beneficial to listeners, such as the speaker's gender, and intonation (Schacter and Church, 1992), the speaker's pitch (Church and Schacter, 1994), and the speaker's voice (Goldinger, 1996). These studies suggest that specific details about the speaker are stored in memory. Section 1.3.1 further discusses specificity effects.

Depending on the time interval between the prime and the target, priming experiments can make use of either the *short-term* or the *long-term* priming paradigm. In the short-term paradigm there are no intervening stimuli between the prime and the target, while in the long-term paradigm the prime and target are separated by a number of lexical items. In the visual modality the time interval between the prime and the target is referred to as the stimulus onset asynchrony (SOA). In the visual priming paradigm the SOA typically ranges from 50ms to 1000ms. Priming has also been observed at long lags such as a one month (Kolers and Ostry, 1974), or even after one year (Kolers, 1976). In the auditory modality the time interval between the prime offset and the target onset is referred to as the inter-stimulus interval (ISI). The ISI for short-term auditory priming experiments is typically between 250ms to 1000ms, but priming effects have been found after a few minutes (e.g., Church and Schacter, 1994), half an hour (e.g., Sumner and Samuel, 2009), or even weeks (Goldinger, 1996).

Another distinction is drawn between *masked* and *unmasked* priming. The masked paradigm is a particularly useful tool to investigate subliminal priming, that is, whether participants can demonstrate priming effects without being consciously aware of the prime word. In the visual domain primes can be masked on a computer screen by a string of characters (e.g., #####). The participant typically only sees the prime itself for 50ms, which is then replaced by the mask for about 250ms, and thus the participant is not consciously aware of the prime (e.g., Jiang and Forster, 2001; Altarriba and Basnight-Brown, 2007). Within the auditory paradigm masking can be achieved by applying noise to the stimulus. This technique is also used to make the task more challenging, thus avoiding a ceiling effect (e.g., Schacter and Church, 1992; Goldinger, 1996).

An important feature of the priming phenomenon is the apparent asymmetry in translation priming with regard to the direction of priming. Bilingual priming experiments consistently show significant priming effects 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.

A handful of studies have found significant L2-L1 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 asymmetry is normally explained by a weaker link between the L2 lexicon and the shared conceptual level, and a stronger link between the L1 lexicon and the conceptual level within the *Revised Hierarchical Model* (Kroll and Stewart, 1994). Before describing this influential model of bilingual lexical representation, a brief overview of early models is given in the following section.

### 1.2.2 Early Models

Weinreich (1953) was the first to propose the theoretical distinction between the lexical level (what he called the *signifier*) and the conceptual level (what he called the *signified*) with regard to bilingual language representation. He proposed three types of bilingual representations: the compound system, the coordinate system, and the subordinate system. In the compound system the L1 and L2 are fused at the conceptual level, but are separate at the lexical level, while in the coordinate system the two languages are independent at both levels. In the subordinate system there is a shared conceptual level but it only links to the L1. That is, the L2 word is just a translation of the L1 word, and the conceptual level can only be accessed through the L1. These three systems of bilingual representation provided the basis for the hierarchical models that followed during the 1980's, which all assume separate lexicons and a shared conceptual store. Empirical evidence for separate L1 and L2 lexicons came from research studies that did not find sufficient repetition priming between the L1 and L2 (that is, interlingual homographs) (e.g., Kirsner et al., 1984; Scarborough et al., 1984), while support for a shared conceptual store came from studies demonstrating strong bilingual semantic priming effects (e.g., Caramazza, 1980; Kirsner et al., 1984).

Weinreich's subordinate system inspired the *Word Association Model*

(Potter et al., 1984). This model assumes direct links between the L1 and L2 lexicons, and between the L1 lexicon and the shared conceptual level, but not between the L2 lexicon and the conceptual level. The *Concept Mediation Model* (Potter et al., 1984) on the other hand assumes direct links between the conceptual representation and the L1 lexicon, as well as the the conceptual representation and the L2 lexicon, but not between the two lexicons. Potter et al. (1984) compared these two models and concluded that L2 processing occurred through concept mediation at all levels of proficiency. Kroll and Curley (1988) challenged this view and instead proposed that the Word Association model accounts for bilingual language representation within low proficiency speakers, while the Concept Mediation Model fits high proficiency speakers. This developmental shift was tested by Kroll and Curley (1988) comparing the results of a translation task with picture naming, which is a conceptual task (similar to the test by Potter et al. (1984), but using participants who clearly belonged to low vs. high proficiency groups). In this study high proficiency speakers were found to be faster in the picture naming task than in the translation task, while low proficiency speakers were faster in the translation task than in the picture naming task. This supported the idea that high proficiency speakers conceptually mediate L2 words, while low proficiency speakers rely on direct lexical translation. Around the same time Kroll and Curley (1986); Kroll and Stewart (1989, 1994) observed that bilinguals consistently translate faster from the L2 to L1, than from the L1 to L2, a result that required modifications to the previous hierarchical models.

### 1.2.3 Revised Hierarchical Model

One of the most influential models of bilingual lexical processing is the *Revised Hierarchical Model* (Kroll and Stewart, 1994). To account for the findings suggesting that bilingual memory is a function of L2 proficiency as well as translation direction, Kroll and Stewart incorporated both the Word Association Model and the Concept Mediation Model into the RHM. This model 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. Figure 1.1 (taken from Kroll and Stewart (1994)) illustrates the shared conceptual level, and the separate lexicons, with the various links connecting the components, where the solid lines indicate strong connections, while the dashed lines indicate weaker links. Strong lexical connections from the L2 to L1 model the bilinguals ease of translation in this direction. That is, for a native French speaker, it is easier to translate *fille* to *girl* than *girl* to *fille* because every L2 word is mapped onto its L1 equivalent, but not every L1 word is mapped onto its L2 equivalent.

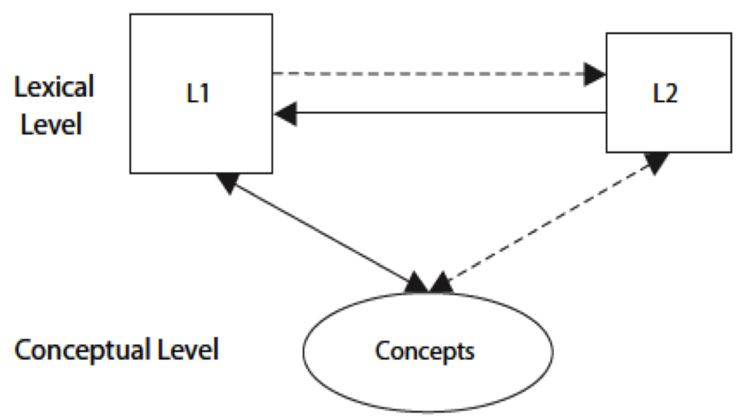


Figure 1.1: The Revised Hierarchical Model (Kroll and Stewart, 1994). Solid lines indicate strong connections, while the dashed lines indicate weaker links.

Over the years many researchers have relied on the RHM to account for their experimental results on bilingual language comprehension. However, in a rebuttal to criticisms by Brysbaert and Duyck (2010), Kroll et al. (2010) reiterate that this model was originally developed as a model of bilingual speech *production*, and not as a model of speech comprehension. In particular, experimental studies investigating bilingual language perception often refer to the RHM to account for the asymmetric priming results. As mentioned earlier, 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. Several studies have found significant L2-L1 priming (Basnight-Brown and Altarriba, 2007; Duñabeitia, Perea, and Carreiras, 2010; Duyck and Warlop, 2009; Schoonbaert, Duyck, Brysbaert, and Hartsuiker, 2009). However, other studies have only found borderline significance or no priming at all (Gollan, Forster, and Frost, 1997; Finkbeiner, Forster, Nicol, and Nakamura, 2004; Jiang and Forster, 2001). These asymmetric results are normally explained by the weaker link between the L2 lexicon and the conceptual level, and the stronger link between the L1 lexicon and the conceptual level within the RHM.

Recently Schoonbaert et al. (2010) examined the L1-L2 vs L2-L1 asymmetric translation priming effects using a English-French visual masked primed lexical decision task. In addition to measuring reaction times they also investigated Event Related Potentials (ERPs). Using ERPs, it is possible to track the time course of language processing during priming more precisely, in order to explore earlier lexical effects or later semantic effects. Schoonbaert et al. (2010) found large N400 (=semantic activation point) effects in both directions, but with a longer lasting L1-L2 effect. They also found large N250 (=lexical activation point) effects for L2-L1, but smaller effect in the L1-L2 direction. These results suggest that the asymmetric pattern is driven by quantitative rather than qualitative differences in processing. The findings also fit in with the predictions of the RHM, which posits that the L2 has strong direct lexical connections with the L1, but the activation from the L1 to L2 relies heavily on semantic mediation. The bilingual priming asymmetry phenomenon will be revisited in Section 2.6.1 with reference to some of the results found in the present study.

The Revised Hierarchical Model has recently come under attack for its assumption of separate L1 and L2 lexicons, and for its assumption of language selective lexical access. Brysbaert and Duyck (2010) argue that there is now ample evidence to suggest that an integrated lexicon is preferred over two separate lexicons. They cite Spivey and Marian (1999) who demonstrated that L1 lexical representations influence the recognition of L2 words, and to a lesser extent L2 representations also influence L1 words.

Spivey and Marian (1999) examined competition effects across the L1 and L2 in an eye-tracking experiment using the visual world paradigm. In this task participants see objects on the screen and are instructed to perform an action on one of them. They gave Russian-English bilinguals the L1 instruction "Poloji *marku* nije krestika" meaning "Put the *stamp* below the cross". One of the items on the screen was a marker (*flomaster* in Russian), which is a cross-language competitor to the Russian word *marka*. Eye-tracking results revealed that participants regularly looked at the picture of the marker before they made the decision to pick up the stamp. This suggests that the L2 names of these objects had been activated, even though this was - on the surface - a monolingual Russian task. These results have been since replicated (e.g., Marian and Spivey, 2003; Weber and Cutler, 2004; Marian et al., 2008), and further evidence of interactions between the L1 and L2 have been found in other studies using various different languages (e.g., van Heuven et al., 1998; van Hell and Dijkstra, 2002; Duyck et al., 2007; Thierry and Wu, 2007).

These studies all show simultaneous activation of L1 and L2 lexical items. But as Brysbaert and Duyck (2010) point out, it is also possible that there are still two separate lexicons activated in parallel by the sensory input. However, van Heuven et al. (1998) found strong phonological neighbourhood effects in the non-target language, which seems to indicate that word representations across L1 and L2 compete with each other in the same way as word representations within a single language, which favours a shared lexicon model. Brysbaert and Duyck (2010) argue that the RHM should be abandoned as a leading model of bilingual lexical processing in favour of connectionist models, such as, for example, the Bilingual Interactive Activation + model.

### 1.2.4 BIA+ Model

The Bilingual Interactive Activation + (BIA+) is a bilingual visual word recognition model developed by Dijkstra and Van Heuven (2002). This model is an updated version of the original Bilingual Interactive Activation (BIA) model by Grainger (1993); Dijkstra and Van Heuven (1998). The BIA+ model assumes common lexical and pre-lexical levels for L1 and L2, which means there is no language selective access. This accounts for the empirical findings showing strong lexical interactions between L1 and L2 word activation (e.g., van Heuven et al., 1998; van Hell and Dijkstra, 2002; Marian and Spivey, 2003; Weber and Cutler, 2004; Duyck et al., 2007; Thierry and Wu, 2007; Marian et al., 2008). This model is interactive in nature and incorporates four levels: sublexical orthography and phonology, lexical orthography and phonology, semantics, and language nodes. On top of the word identification system there is also another system designed to deal with higher-level task effects, which captures the fact that word identification is also controlled by the context in which the language processing occurs. These effects include task demands and participant expectations. The model is illustrated in Figure 1.2. During word recognition the following steps occur. Given an orthographic input, several lexical candidates are activated in parallel depending on the level of similarity to the input, and on the resting level activation of the individual candidates. The latter is dependent on the frequency and recency of use, as well as L2 proficiency. Although the BIA+ assumes non-selective language activation, L2 representations are activated more slowly than L1 representations. This is likely due to the lower frequency of stored L2 representations. Once the orthographic representations are active, they in turn activate phonological and semantic representations associated with them.

The priming asymmetry discussed earlier can also be accommodated by the BIA+ model. The critical factor that determines the accessibility of a given word is the frequency and recency of use of that word. The idea underlying this assumption is that the more often and more recently a word is encountered, the faster its recognition will be. Therefore, the translation priming asymmetry is explained in terms of the lower accessibility of the L2 prime words, which are less frequently used than the L1 words.

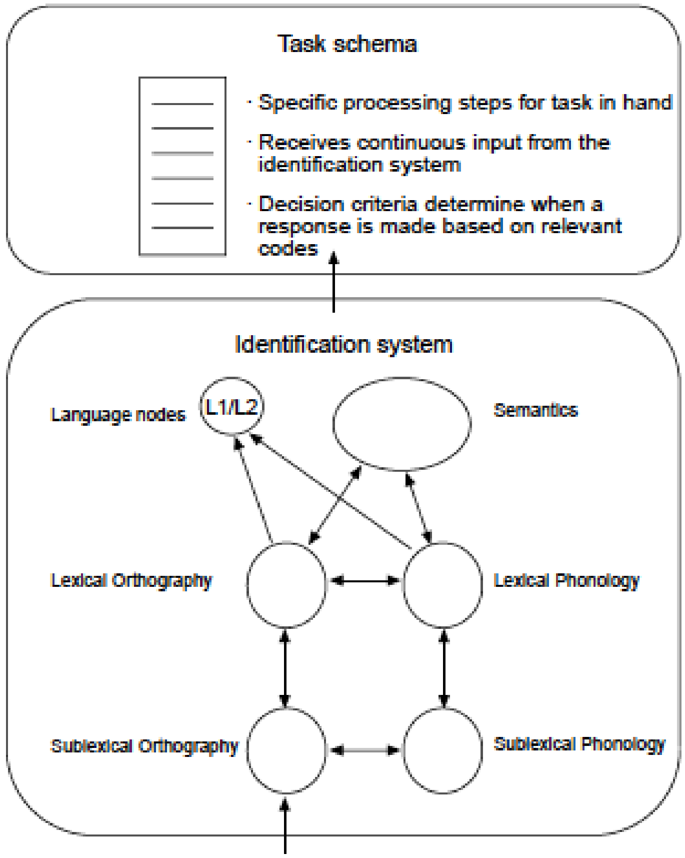


Figure 1.2: The BIA+ model (Dijkstra and Van Heuven, 2002)

The BIA+ model also includes language nodes. These nodes serve two different purposes; they function to reinforce lexical activations of the currently activated language, and at the same time decrease lexical activations in the other lexical system. Dijkstra and Van Heuven (2002) assume that as bilingual speakers know which language a word belongs to, there must be some sort of language tag or language membership representation, which can be retrieved from the current lexical input or previous sentence context, for example.

Models positing a shared lexicon often assume that L1 and L2 words are tagged for language. Green (1998) draws a parallel between the language nodes and language tags in general, and states that it is quite unclear whether they are a necessary component of bilingual processing. Green suggests that an alternative might be to assume lexical and grammatical learning in a simple recurrent network or in a self-organizing neural network, in which no distinct labels are given to items of the two or more languages. Language-tag models were originally developed in the 1970's (McCormack, 1976). In these models each word in memory is tagged – or labelled – with the language to which it belongs. Language tagging is still a part of some current models of bilingual lexical processing. Recently Sundara and Scutellaro (2011) appeal to language tagging to account for their results. Using a visual habituation procedure, Spanish-English learning bilingual infants were tested on the ability to discrimination the vowels /e/ and /ɛ/, which are phonologically contrastive in English but not in Spanish. The authors suggest that infants use a tagging and sorting mechanism in order to separate the two languages, and test if infants learning two rhythmically different languages like Spanish and English would be able to better deal with the overlapping distribution of vowels in the two languages. Indeed, the results revealed that 8-month old Spanish-English learning bilingual infants were able to successfully discriminate the two vowels. Previously in a study by Bosch and Sebastián-Gallés (2003), Catalan-Spanish learning bilingual infants were unable to discriminate the Catalan /e/ - /ɛ/ distinction. Sundara and Scutellaro (2011) argue that Catalan and Spanish are rhythmically too similar, which makes it difficult for infants to track two sets of statistics simultaneously in Catalan and Spanish. However, the apparent rhythmic difference between Spanish and English enable bilingual infants to easily tag and separate the two languages, and then apply statistical learning mechanisms to each set.

The assignment of language tags to each L1 and L2 lexical item might operate in a similar fashion to the way lexical items are labelled with social information. The effect of social information on speech perception is discussed in the following section.

## 1.3 Variation in Speech Perception

### 1.3.1 Talker-Specific Details in Memory

As mentioned briefly in Section 1.2.1, auditory priming studies have demonstrated that talker specific details are stored in memory, and that these details are accessed during speech perception. Craik and Kirsner (1974) showed that participants were not only faster at responding to repeated items, they were also faster at responding to previously heard, repeated voices. Other studies have also shown that contextual details are represented in long-term memory and beneficial to listeners in word-recognition tasks. These talker-specific details include the speaker's gender and intonation (Schacter and Church, 1992), the speaker's pitch (Church and Schacter, 1994), the speaker's voice (Goldinger, 1996; Pisoni, 1997; Bradlow et al., 1999), speech rate (Bradlow et al., 1999), and to some extent amplitude (Bradlow et al., 1999). The priming effect is largest when the prime and target are exact replicas of each other, and the magnitude of priming decreases when the prime and target differ on some contextual detail. If the priming effect is significant in both cases, that suggests that listeners are sensitive to both abstract and specific matches, and benefit from both sources of information during lexical processing.

The results of the above mentioned studies support models of lexical representation that assume that variability is incorporated into lexical representations along with linguistic content. Previously it had been assumed that the mental lexicon contained abstract canonical representations that have been stripped from all detailed phonetic information. In these abstractionist-only models variability in speech – such as, for example, socially conditioned phonetic information – is treated as 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 Cutler et al. (e.g., 2010) for a an abstractionist view on speaker-related variation, where retunement of phonemic categories is a necessary part of lexical access.) Cutler (2008) argues for abstract lexical representations as well as abstract pre-lexical representations. On the other end of the spectrum, episodic theories argued that word representations are composed of detailed memory traces of auditory experiences (e.g., Klatt, 1981; Goldinger, 1996; Luce and Pisoni, 1998; Goldinger, 1998; Johnson, 1997; Pisoni, 1997; Bradlow et al., 1999). Exemplar-based theories propose that phonetically detailed episodic memories of utterances are represented together with socially indexed information (e.g., Johnson, 1997; Pierrehumbert, 2001). 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., Pierrehumbert, 2002; McLennan et al., 2003; Luce et al., 2003; Sumner and Samuel, 2009). For example, in the neo-generative model of speech perception (Pierrehumbert, 2002), abstract categorization emerges through generalizations over probabilistic distributions of phonetic realizations. These hybrid models assume that both abstract and specific representations are present, and suggest that the abstract and episodic codes cooperate in spoken word recognition.

### 1.3.2 Effect of Social Information on Speech Perception

The previous section briefly reviewed some evidence about talker-specific contextual details being stored in memory along with linguistic information. It is then perhaps not surprising that listeners regularly make use of social information associated with particular speakers during speech perception.

The idea that speech perception happens in context has been around for a long time. Ladefoged and Broadbent (1957, pg. 98) stated that in addition to linguistic information, as listeners "we also receive information of a different kind about the general background of the speaker; thus we can usually infer something about a speaker's place of origin and his social status from his accent."

Studies have shown that how phonetic variants are perceived can be influenced by what social characteristics are attributed to the speaker. In an audio-visual study Strand (1999), for example, presented gender-ambiguous

/s/ and /ʃ/ tokens along with short video clips of men and women. She found that listeners were more likely to hear the same fricative as /ʃ/ when presented together with the video of a female. This results suggested that the faces and voices of speakers activated stereotypes about gender, which then affected listeners' perception of /s/ and /ʃ/.

Niedzielski (1999) found that in a vowel matching task participants' responses shifted because of their expectations about the speaker's regional dialect area. She investigated Canadian Raising using the /au/ diphthong, which is pronounced with a raised vowel in both Canada as well as Detroit. However, speakers in Detroit are not aware that they produce this variant, and only associate it with Canadian speech. Participants from Detroit were instructed to match a vowel from natural speech to a vowel from a synthesized continuum. In one condition, the label *Canada* was written on top of the answer sheet, while in the other condition the label said *Michigan*. Niedzielski (1999) found that listeners were more likely to respond with a raised vowel if they were in the Canada condition than if they were in the Michigan condition.

In a similar fashion Hay et al. (2006) also demonstrated that the mere exposure to the concept of a region with a different dialect is enough to cause a shift in perception toward variants of that dialect. Participants matched synthesized tokens of /ɪ/ to a vowel from a sentence from natural speech, and either *Australian* or *New Zealander* appeared at the top of the answer sheet. They found a bias in perception of /ɪ/ toward more Australian-like variants for female participants in the Australian condition.

In a follow up study Hay and Drager (2010) report on an experiment designed to test the degree to which exposure to the concept of a region can influence perception. In order to invoke the concept, they exposed participants to either stuffed toy kangaroos and koalas (associated with Australia) or stuffed toy kiwis (associated with New Zealand). These objects in the room that were seemingly unrelated to the task also caused a shift in perception, just like the written labels did in Hay et al. (2006).

Regional dialect, of course, is just one of many social variables that can affect speech perception. The perceived age of speaker can also influence the perception of vowels, for example. Drager (2006) and Drager (2011) shows that the age attributed to a speaker influences the categorization of vowels which are undergoing change in New Zealand English. The short front vowels have been involved in a push chain, such that TRAP has raised into the space of DRESS, DRESS has raised into the space of KIT, and KIT has centralized (Gordon et al., 2004; Langstrof, 2006).[1] The change is ongoing, thus younger speakers in New Zealand have higher variants of both DRESS and TRAP than older speakers (Maclagan and Hay, 2007). The results in both Drager (2006) and Drager (2011) demonstrate that listeners shift their category boundaries between DRESS and TRAP depending on the perceived age of the speaker.

It is important to note that not all listeners are affected by a speaker's social characteristics to the same degree, and the listener's previous linguistic experience plays a crucial role in speech perception. The amount of previous exposure to other dialects has been shown to affect listeners' ability to identify social characteristics of a speaker, such as regional dialect (e.g., Clopper, 2004), and ethnic dialect (e.g., Szakay, 2008). Previous exposure can affect not only the ability and accuracy to identify language varieties, it can also have an effect on the way different speech varieties are processed and represented in the mind (Sumner and Samuel, 2009).

### 1.3.3 Perception and Representation of Dialect Variants

Assuming a hybrid model of language representation, Sumner and Samuel (2009) investigated what role episodic and abstract representations play in cross-dialect variant processing for groups of listeners who have different levels of familiarity with a dialect. Sumner and Samuel (2009) 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 for speakers. In a series of three experiments Sumner and Samuel (2009) examined the processing and mental representation of non-rhotic New York City (NYC) and rhotic General American (GA) dialect

[1]The lexical set labels TRAP, DRESS, and KIT Wells (1982) are used to refer to the vowels in each of the respective words.

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. Four conditions were created; two within-dialect, and two across-dialect 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 the second experiment Sumner and Samuel (2009) used a short-term semantic priming paradigm. In this task each target (e.g., *thin*) was paired with a related prime (e.g., *slender*) in the critical conditions, and with an unrelated prime (e.g., *pepper*) in the control conditions. Here only the primes ended in -er, the targets did not. The results of this experiment were similar to the previous experiment, where the two NYC-raised groups produced identical priming patterns, while the GA-raised participants' results differed. The GA participants showed strong semantic priming when the prime was a within-dialect GA item, but the out-of-dialect NYC primes were ineffective in priming semantically-related items.

In the third 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 or semantic processing. In the long-term priming paradigm the stimuli were presented in two blocks, with critical items in the first block acting as primes for targets presented in the second block. This way the time interval between a prime and its target was around 20-30 minutes. The critical stimulus material was the same as in the first experiment, that is identical words with two different surface representations, e.g., [beɪkɚ] and [beɪkə]. This technique can be used to assess whether a variant (e.g., [beɪkə]) is stored in a lexical form that can produce priming (e.g., for [beɪkɚ]) over the long-term, and whether such representational forms differ as a function of the dialect of the listener. 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.

The results of this study provide evidence for dialect-specific lexical representations. In the long-term paradigm the Overt-NYC participants seem to encode both variants of final -er equally well, and both the rhotic and non-rhotic forms are able to facilitate the recognition of either form even after half an hour. The Covert-NYC and GA listeners appear to encode only the GA rhotic -er form.

### 1.3.4 A Dynamic Interactive Theory of Person Construal

Social psychologists have long been interested in person categorization. It was traditionally assumed that categorizing other people reduces the cognitive demands on dealing with others (e.g., Sherif, 1948; Allport, 1954; Tajfel, 1969). These seminal writers had a major influence on person perception and social categorization research. It was believed that the mere exposure to a person immediately activated the social categories associated with that person. These categories, such as sex, race, and age, for example, would then trigger certain cognitive and affective behaviours (Freeman and Ambady, 2011). At the same time, cognitive psychologists were interested in person perception from a low-level processing perspective, such as face-perception (e.g., Burton et al., 1990; Calder and Young, 2005, - as cited in Freeman and Ambady 2011). Recently a new line of research has emerged, referred to as person construal research, which aims to integrate the higher-level social cognitive framework with the low-level perceptual processing research from cognitive psychology. As part of this growing body of research, Freeman and Ambady (2011) provide a dynamic interactive theory of person construal. This framework explains social categorization processes at a perceptual level and links these processes to higher-order social cognitive phenomena. Figure 1.3 shows the diagram of the model. It has a connectionist architecture (reminiscent of the BIA+ model of bilingual word recognition), with four different levels interconnected through excitatory and inhibitory links. The model can take both visual and auditory input, which directly stimulate the cue nodes from the bottom-up. These can include face and body cues from the visual input, or voice cues from the auditory input. The cue level is in turn connected to the category level, which has various competitive social category pools (e.g., sex, race, age). Each of these pools contains category nodes, such as female, white, young, happy. Competing nodes (e.g., female vs. male) inhibit each other, that is, they are connected through a negatively weighted connection. On the other hand, nodes that excite each other (e.g., male might activate angry) have a positively weighted connection. The activation level of a node changes over time, depending on its prior activation, how fast it decays, and the total input it receives from other nodes. The category level is also connected to a stereotype level, which has one pool containing the nodes for all category-related stereotypes (e.g., aggressive, docile). Both the category level and the stereotype level are connected to the higher-order level. This level contains high level cognitive states – such as task demands, situational context, prejudice, and motivations – and can directly influence both the stereotype and the category levels in a top-down manner.

To illustrate how this interactive model works, let us consider an example given by Freeman and Ambady. In a race identification task, when the network is presented with a face as visual input, the cue nodes are directly activated. This could include Male Cues, Female Cues, Black Cues, and Asian Cues. Inconsistent cues will mutually inhibit each other, for example Male Cues vs. Female Cues, as well as Black Cues vs. White Cues vs. Asian Cues. Cue nodes also excite category nodes that are consistent with them, and inhibit category nodes that are inconsistent with them (these would include Male, Female, Black etc.) At the same time higher level input will also activate higher level nodes. Because this task is a race identification task, the category nodes Black, Asian, and White will be excited, while the category nodes Male and Female will be inhibited by the top-down attentional system. The stereotype nodes Aggressive and Docile, for example, will also be activated by certain category nodes, it might be the case that Female and Asian both excite Docile, and Male and Black excite Aggressive. Through a number of iterations the activation level of each node strengthens or weakens, and eventually settles into a steady state. That is, in this model perceptions of other people gradually emerge through interaction between social categories, stereotypes, and the low-level processing of visual and auditory cues. For the exact values of activation links from a computational point of view see Freeman and Ambady (2011), who also demonstrate how the model is capable of accounting for various perceptual phenomena, such as stereotype activation, racial prejudice, or the interaction of voice processing with face processing in sex categorization with typical, as well as atypical input cues.

Section 5.2 in the concluding chapter will provide an instantiation of this dynamic interactive model of person construal based on the results of the present study, using auditory input from Māori, Māori English and Pākehā English. The next section gives a brief overview of the Māori language, and the Māori English variety of New Zealand English.

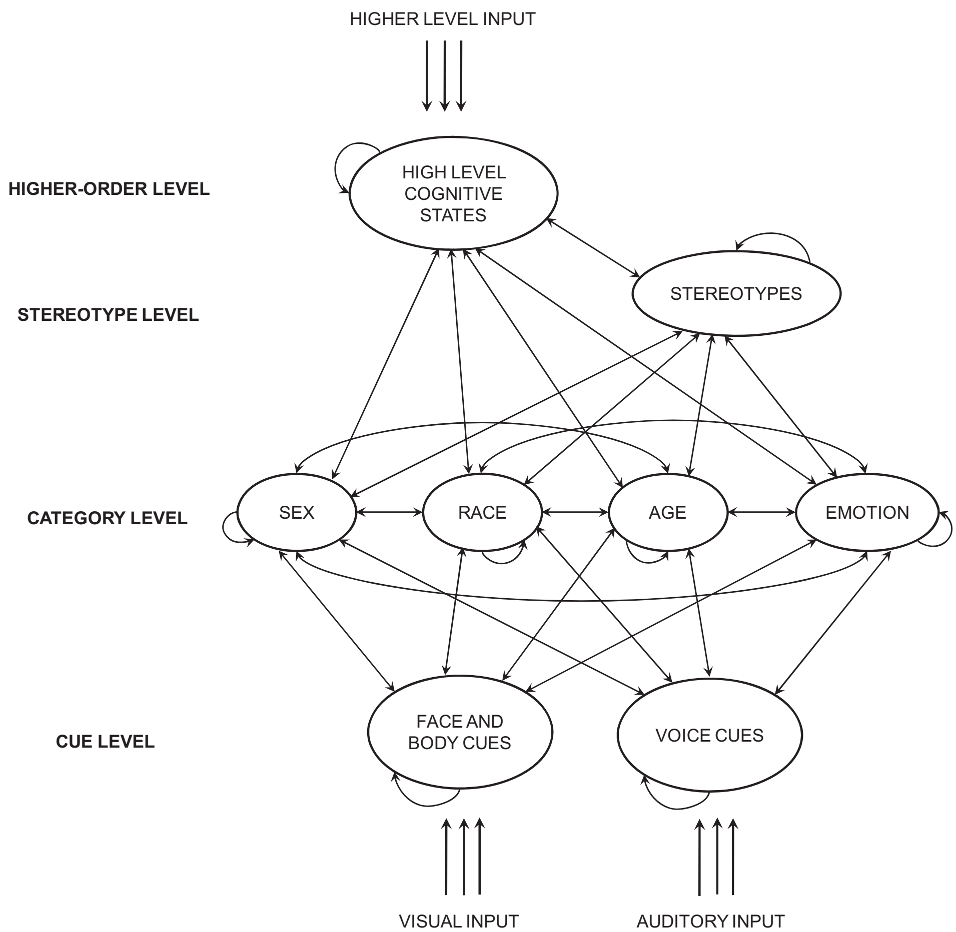


Figure 1.3: Diagram of the dynamic interactive model of person construal (Freeman and Ambady, 2011).

## 1.4 The Linguistic Landscape of New Zealand

New Zealand has three official languages: English, Te Reo Māori (= the Māori language), and New Zealand Sign Language. New Zealand English itself has two main varieties, namely Māori English, spoken mainly by the indigenous population, and Pākehā English, which is the standard English variety spoken mainly by people of European descent. The sections below provide a brief introduction to Māori and Māori English. Māori English is generally defined and described in terms of its differences from the standard Pākehā English variety. For a detailed historic and linguistic introduction on the Māori language, refer to Harlow (2007).

### 1.4.1 Māori Language

The Māori language is the indigenous language of New Zealand. It is an Austronesian language, belonging to the Eastern Polynesian branch of the Polynesian subgroup. Its closest relatives include Cook Islands Māori and Tahitian, but it is also related to Hawaiian, Tongan, and the language of Rapanui (Easter Island) among many others. Māori was brought to New Zealand about 800-1000 years ago ago by voyagers from Central Polynesia. Māori became a minority language in the 1860's and was banned in schools by the 1880's. A hundred years later less than 20% of the Māori population was fluent in the language. The realization of this sad fact brought about huge language revitalization efforts, starting during the 1980's. Kōhanga reo (=language nests) were set up all over the country, where the elderly native speakers of Māori provided total immersion schooling for young children. According to the 2006 census taken by Statistics New Zealand, the country has a population of 4.098 million. The census data indicates that 14.6% (565,329) of New Zealanders identify themselves as belonging to the Māori ethnic group. The Māori language is spoken by 4.1% of the population, and 23.7% of all ethnically Māori New Zealanders. Most of these speakers of Māori are second language speakers.

Māori has developed some regional variation, but all varieties are mutually intelligible. The language has ten consonants and five monophthongs, presented in Table 1.1. Vowel length is contrastive, and all sequences of a low vowel followed by a high vowel, plus a few others, can form diphthongs (Harlow, 2007). As the GOAT vowel will prove to be important in this study, it is interesting to point out here that Māori does have an /ou/ diphthong, which is auditorily more similar to the Pākehā English GOAT vowel than to the Māori English GOAT vowel.

Table 1.1: The consonants and vowels of the Māori language.

| | |
|---|---|
| Consonants: | p t k m n ŋ f h r w |
| Vowels: | a e i o u |

### 1.4.2 Māori English

The number of fluent, native Māori language speakers has steadily decreased in New Zealand, and English has become the dominant language of almost all Māori people, although many are also familiar with the Māori language. In such circumstances, it is not surprising that a distinctive variety of Māori English has emerged to express ethnic identity and positive attitudes toward Māori culture (Holmes, 2005). Māori English is "now regarded as the fastest growing variety of New Zealand English" (Maclagan et al., 2008a, pg. 668), with its features diverging from the standard dialect (Pākehā English) at a fast pace. However, as recently as two decades ago, linguists' efforts to identify unique Māori English features proved to be mostly fruitless. Benton (1991, pg. 195) pointed out that "the evidence for the existence of Māori English as a distinct and stable... variety of New Zealand English is at best tentative and ambiguous". However, he also noted that "it would be surprising if the... identifiable and distinctive Māori subculture in New Zealand... did not in some way manifest this identity and distinctiveness in the English speech of its members" (quoted in Maclagan et al. 2008a, pg. 661). A few years later Bayard (1995, pg. 151), summarizing the results of ethnic identification experiments, concluded that "in many cases New Zealanders cannot accurately distinguish Pākehā from Māori and Polynesian New Zealanders on the basis of accent... However, they think they can...". In the decades since, the situation has changed considerably. Production experiments have found significant differences between the two dialects at both the segmental and suprasegmental levels. Māori English speakers have been shown to produce a higher percentage of final-z devoicing, GOOSE fronting (Bell, 2000), θ-fronting (Kennedy, 2006), and a monophthongized GOAT vowel with a fronted and raised onset (Maclagan et al., 2008b). Suprasegmental features have probably become the most salient differences between the two varieties. Māori English has a significantly more syllable-timed rhythm (Holmes and Ainsworth, 1997; Warren, 1998; Szakay, 2006, e.g.,), more High Rising Terminal contours in its intonation (Warren and Britain, 2000; Szakay, 2008), and a higher overall mean pitch (Szakay, 2006). New Zealand listeners have also become more attuned to these differences, and are able to identify the ethnicity of a speaker, even from suprasegmental cues alone (Szakay, 2008, 2012).

How much of these features are transfer effects from the Māori language? Maclagan et al. (2008a) argue that any features of the Māori English that were originally linked with the Māori language are now probably being passed on generation by generation in the absence of the language which gave rise to the features, and cite Richards (1970, pg. 126) stating that "although it is meaningful to look for interlingual interference in the initial stages of language contact after a century of existence such efforts should be abandoned." Even with today's revitalization efforts, major influence from the Māori language seems unlikely because the English skills of bilingual children in immersion schools are comparable to the English skills of Māori children in mainstream schools (Murray, 2005, pg. 4 - cited in Maclagan et al. (2008a)).

One important observation to point out is that not all ethnically Māori New Zealanders speak Māori English, and some Pākehā speakers (that is, speakers of European decent) also use Māori English features in their speech (King, 1993). The segmental and suprasegmental differences mentioned above are also not absolute between the two varieties; rather, there is a quantitative difference where Māori English speakers make use of these features in higher proportions than Pākehā English speakers. These facts all support the idea that Māori English is better thought of as an ethnolinguistic repertoire available to speakers, rather than a distinctively ethnic variety. The notion of ethnolinguistic repertoire was put forward by Benor and is defined as "a fluid set of linguistic resources that members of an ethnic group may use variably as they index their ethnic identities" (Benor, 2010, pg. 160). In this dissertation I use the terms *ethnic variety* and *ethnic* *dialect* as shorthand, fully acknowledging the fact that there is variation and fluidity within both Māori English and Pākehā English, where speakers may use more or less of the available features depending on the context and what social meaning they are trying to convey.

## 1.5 Organization of the Dissertation

As part of this dissertation project three experiments were run. Chapter 2 describes a short-term auditory lexical decision task. This experiment investigated the effect of dialect on immediate bilingual speech processing. The goal of this experiment was to understand whether bilingual processing of L1 and L2 forms is affected by L1 ethnolectal variants. In the short-term auditory primed lexical decision task, prime and target pairs are presented over headphones with an inter-stimulus interval (ISI) of 250 ms between them. The listener's task is to decide whether the target word is a real word or a pseudo-word, and press one of two buttons accordingly. English(L1)–Māori(L2) bilinguals participated in the short-term auditory lexical decision task, where 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 standard New Zealand English speaker, and half by a Māori English speaker, thus creating nine test conditions: four bilingual conditions, four English-only conditions (two within dialect, two cross-dialect), and a within Māori repetition priming condition. By measuring participants' accuracy and reaction times to different types of stimulus material we can gain insight into the strategies by which different dialectal forms in bilingual short-term memory are processed. In order to account for some asymmetric priming patterns found in the within-English conditions, a follow-up experiment was run, where listeners evaluated all critical words on a scale of how Māori or Pākehā sounding each item was using a Visual Analogue Scale. This experiment is presented in Chapter 3. Chapter 4 of the dissertation describes the second main experiment of this study. This experiment is similar to the first one, except it uses a long lag of 20-30 minutes between primes and targets. The long-term auditory primed lexical decision task investigates the effect of ethnic dialect on bilingual language representation, as opposed to immediate short-term processing. The results of the three experiments are summarized in Chapter 5, which also provides an extension of the dynamic interactive model of person construal (Freeman and Ambady, 2011) into the bilingual domain.

# Chapter 2

# Effect of Dialect on Bilingual Lexical Processing

## 2.1 Chapter Overview

The main question this chapter seeks to answer is whether social information relating to ethnic categories present in the L1 speech signal has an effect on the processing of L2, and vice versa. A cross-language/cross-dialect short-term auditory primed lexical decision experiment was run to examine the effect of ethnic dialect on bilingual language processing. After a short introduction, the methods of the experiment are described in Section 2.3. To interpret the results of the lexical decision task, two performance measures were analyzed: Sensitivity (Section 2.4) and Reaction Time (Section 2.5). Results from the bilingual conditions provide support to the hypothesis that socio-indexical labelling operates under a shared system across the L1 and L2, which is discussed in Section 2.6. The chapter conclusion is given in Section 2.7.

## 2.2 Introduction

Previous research 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 chapter examines whether the activation of social information operates under a *shared* or a *separate* system across the two languages for bilingual talker-listeners. I argue for a shared system, showing that L1 socio-indexical labels interact with L2 indexical labels during speech perception. Socio-indexical features in speech are those aspects of linguistic structure which correlate with non-linguistic factors Abercrombie (1967). These factors include, for example, speaker differences in gender, age, socio-economic status, ethnicity, group affiliations, regional background, and individual identity. In particular, the present study examines the effect of ethnicity on bilingual language processing.

The main hypothesis behind this study is that the activation of social categories operates under a shared system across the L1 and L2. Based on this hypothesis I predict that activating lexical items associated with a particular ethnicity in the L1 will in turn activate linguistic material in the L2 that is also associated with the same ethnicity. Figure 2.1 demonstrates the hypothesized operation of social category activation under a shared system across the two languages of a bilingual listener, where social categories can activate and interact with each other across the L1 and L2 lexicons in both directions. The model presented in Figure 2.1 is influenced by the the neo-generative model of speech perception (Pierrehumbert, 2002) and by the dynamic interactive model of person construal (Freeman and Ambady, 2011). In this model phonetic representations are associated with relevant social categories, while lexemes are dynamically updated abstract generalizations over probabilistic distributions of such phonetic representations. The hypothesized L1-L2 social category activation operates in the following way. Phonetic representations of the English lexeme *snow*, for example, that have an innovative fronted and raised diphthong are associated with Māori ethnicity, while phonetic representations with the standard GOAT diphthong are associated with Pākehā ethnicity. Phonetic representations of Māori language lexemes will be associated with Māori ethnicity. Being exposed to the Pākehā English phonetic representation [snou] will activate the concept of *snow*, which in turn will pre-activate the Māori translation equivalent *huka*, through previously proposed conceptual links (e.g., Kroll and Stewart, 1994), and hence facilitate the processing of *huka*. In a similar fashion, being exposed to the Māori English phonetic representation [snu] will also activate the concept of *snow*, which in turn will pre-activate the Māori translation equivalent *huka*. However, in addition to this lemma activation link, the Māori English phonetic representation [snu] will also activate other phonetic representations associated with Māori ethnicity, including the L2 translation equivalent [huka]. Due to the additional social category activation link, this will result in a stronger activation of [huka] by the Māori English phonetic representation [snu], than by the Pākehā English phonetic representation [snou]. In Figure 2.1 (and other similar figures in the thesis) the Pākehā English phonetic representation of *snow* is transcribed as [snou], while the Māori English phonetic representation is transcribed as [snu]. This is only for ease of transcription, and does not mean to suggest that the the ME GOAT vowel is pronounced as the /u/ vowel in GOOSE. It simply means to represent that the ME vowel is fronted, raised, and more monophthongal than the PE vowel.

## 2.3 Methods

### 2.3.1 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 2.1 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].

Eighty-one critical English-Māori translation pairs were created (for a

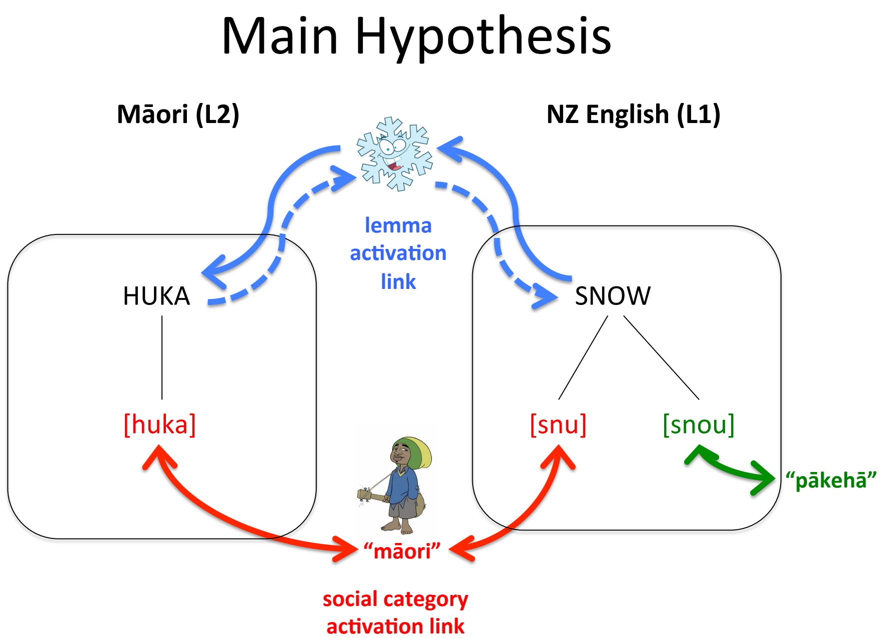


Figure 2.1: Hypothesized operation of social category activation under a shared system across the two languages of a bilingual listener. Social categories can activate and interact with each other across the L1 and L2 lexicons in both directions. (In this and following figures the "Māori" ethnic category is represented by a cartoon character, Jeff da Māori, from the TV series *bro'Town* (Mitchell, 2004)).

complete list see Table 1 in Appendix One) 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.[2] However, θ-fronting, GOOSE-fronting, and final-z devoicing are also used by PE speakers to some extent. To serve as controls in the priming task, eighty-one unrelated pairs were also created by randomly re-pairing items from the critical

[2]Chapter 3 describes a perception experiment where listeners rated all words produced by these six speakers in terms of how Māori- or Pākehā-sounding the speakers were.

Table 2.1: Examples of all combinations of prime and target pairs, illustrated by the English-Māori translation pair *thing* and *mea*.

| 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* |

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 in Māori English could potentially create homophones (e.g., θ-fronting: *thin–fin*, or final-z devoicing: *phase–face*). English and Māori filler and pseudo-words were also included. The English filler words were real words that did 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.

Every prime word was produced by one of the three female speakers, while all target words were produced 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 similarity effects.

The word lists were presented on a MacBook Pro laptop screen for the speakers to read out loud at their own pace. The sound files were recorded directly onto the laptop by the built-in microphone as mono sound using

Praat. The original sampling frequency of 44,100 Hz was resampled to 22,050 Hz in Praat. A Praat script was then used to automatically segment the recordings into individual words. Another script created a TextGrid object for a LongSound object, and set boundaries at pauses on the basis of an intensity analysis. These boundaries were then hand corrected to accurately mark the beginning and the end of each word. A third Praat script was then used to extract all words from the long sound file and write them into individual .wav files. Finally, the amplitude of each sound file was scaled to 70 dB.

To determine whether there were any differences in word length across the speakers an ANOVA was carried out with target word duration as the dependent variable. The analysis showed a significant effect of language variety ($F(2,726)=148.1$, $p<.001$). Post-hoc analysis revealed that the Māori English target words are significantly longer than both the Pākehā English target words (Tukey's HSD, $p<.001$) and the Māori language target words (Tukey's HSD, $p<.001$).[3] Differences in word duration were also investigated with regard to the four phonetic variables contained in English critical items. An ANOVA revealed an effect of variable ($F(3,77)=11.65$, $p<.001$), and post-hoc analysis indicated that words with the final-z variable are significantly longer in duration than words containing the other three variables (Tukey's HSD, $p<.001$). This is true for both the Pākehā English and the Māori English speaker. No other significant length differences were observed with regard to the phonetic variables.

Frequency information for the English words was obtained from the CELEX database (Baayen et al., 1993) (log values for critical items: mean = 2.97, range = 1.5–4.7). The frequency information for the Māori words came from a PhD dissertation by Boyce (2006), which involved the compilation of a Māori language written broadcast corpus (log values for critical items: mean = 1.76, range = 0–3.8). An ANOVA showed no significant differences between the frequency distributions of critical English items with regard to

[3]This might at first seem like a reason to worry, as longer words typically elicit longer response times. However, many of the results in this dissertation will reveal faster response times to Māori English targets under certain circumstances.

the four different phonetic variables.

### 2.3.2 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 design, nine separate counterbalanced lists were created, as illustrated in Figure 2.2. Each cell in the figure represents nine prime-target pairs, which gives a total of 45 critical pairs and 36 control pairs. On top of these critical and control pairs, each list also includes filler pairs and pseudo-target pairs, both of which also feature all nine conditions. Filler and pseudo-target pairs did not vary across lists. Note, that because the critical pairs and their corresponding control pairs within the same condition were always on separate lists, only across-subject analyses will be carried out. In an ideal situation each list would contain both critical and control trials for a particular condition. However, with regard to this study, that would either require a lot more critical English-Maori translation pairs available as stimuli (the critical English words were already heavily constrained by having to include one of the four sociophonetic variables), or it would require the creation of more than nine separate lists. Recall from Section 1.3.3 that Sumner and Samuel (2009), for example, had four different conditions, and thus created 16 counterbalanced lists, where each list included both critical and control trials (of course, with different lexical items in each) within a particular condition. This way they were able to carry out a within-subject analysis. In the present study, however, having nine different conditions means that for a within-subject analysis 81 separate lists would have to be created.

| | LIST 1 | LIST 2 | LIST 3 | LIST 4 | LIST 5 | LIST 6 | LIST 7 | LIST 8 | LIST 9 |
|---|---|---|---|---|---|---|---|---|---|
| critical trials | ME-ME | ME-ME | ME-TR | ME-PE | ME-PE | ME-PE | ME-ME | ME-ME | ME-ME |
| | ME-TR | ME-TR | PE-ME | ME-TR | PE-PE | ME-TR | PE-ME | ME-PE | ME-PE |
| | PE-PE | PE-ME | PE-PE | PE-TR | PE-TR | PE-PE | PE-TR | PE-ME | PE-ME |
| | TR-ME | PE-PE | TR-ME | TR-ME | TR-ME | PE-TR | TR-PE | TR-PE | PE-TR |
| | TR-TR | TR-ME | TR-TR | TR-PE | TR-PE | TR-PE | TR-TR | TR-TR | TR-TR |
| control trials | ME-PE | ME-PE | ME-ME | ME-ME | ME-ME | ME-ME | ME-PE | ME-TR | ME-TR |
| | PE-ME | PE-TR | ME-PE | PE-ME | ME-TR | PE-ME | ME-TR | PE-PE | PE-PE |
| | PE-TR | TR-PE | PE-TR | PE-PE | PE-ME | TR-ME | PE-PE | PE-TR | TR-ME |
| | TR-PE | TR-TR | TR-PE | TR-TR | TR-TR | TR-TR | TR-ME | TR-ME | TR-PE |

Figure 2.2: The nine counterbalanced experimental lists showing the *critical* and *control* trials. Each list contains all nine conditions. For each condition the corresponding critical and control pairs are presented on separate lists.

The distribution of the four socio-phonetic variables among the 81 critical English lexical items used in the experiment was nearly equal: 20 contained the GOOSE vowel, 20 contained the GOAT vowel, 20 contained a final-z, while 21 words contained a θ. Each of the nine counterbalanced lists featured a total of 54 English critical/control targets, that is, those target words that contain the sociophonetic variables: 13 with a GOOSE vowel, and depending on the list 12-13 words with the GOAT vowel, 13-14 words with a final-z, and 14-16 words with a θ.

Because of the use of two different English dialects in this cross-language and cross-dialect paradigm, two-thirds of the words contained in the critical and control pairs were in English, and only one-third in Māori. To make up for this difference, proportionately more Māori words than English words were used as fillers, to result in an overall 50% English words and 50% Māori words ratio in the experiment.

Altarriba and Basnight-Brown (2007) urge researchers to pay close attention to parameters such as the non-word ratio and the relatedness proportion when designing priming experiments. The relatedness proportion refers to the proportion of related prime-target trials out of all the prime-target trials. Semantic priming has been found to increase in magnitude as the relatedness proportion increases (de Groot, 1984). In other words, if the majority of word pairs in the experiment are related, participants tend to create expectancy sets as it improves their performance. In order to gain a fair estimate of priming effects it is crucial to keep the proportion of related pairs low. Researchers also need to make sure that the number of non-words matches the number of real words in the experiment. If there are more than 50% non-words present, participants might become biased to give a non-word response. Similarly, if the experiment contains more than 50% real words, participants might become biased to give a real word response. Keeping this in mind, each list in our experiment was designed to include 45 critical (=related) pairs, 36 control (=unrelated) pairs, 99 filler pairs, and 180 pseudo-target pairs, resulting in a total of 360 pairs. This way the real word/non-word ratio is 50%, while the relatedness proportion is sufficiently low at 30%.

### 2.3.3 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 250 ms 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. Subjects were instructed to press the right arrow key for a *real word* response, and the left arrow key for a *non-word* response. Participants had 2.5 seconds available to make a lexical decision on the target word. Figure 2.3 provides a visual representation of the experimental procedure. The experiment started with eight practice trials, after which subjects were allowed to ask questions and clarifications.

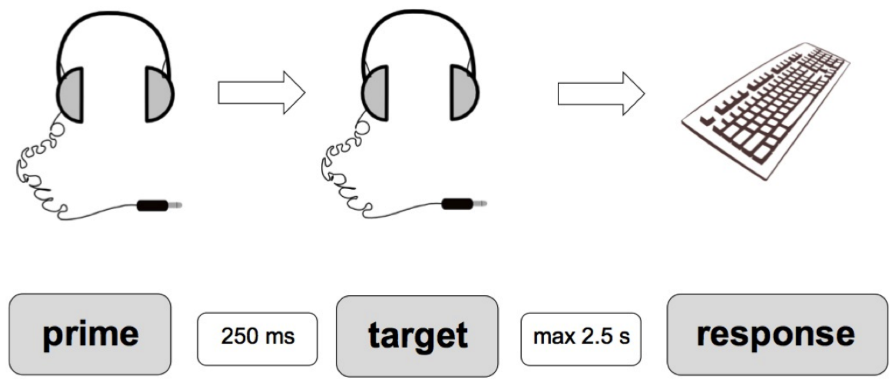


Figure 2.3: Experimental procedure for the short-term auditory primed lexical decision task.

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 instructed to respond as fast as possible without compromising accuracy. As feedback, their reaction time was displayed on the screen after each trial for 1.5 seconds, 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. Stimuli were presented in a different random order for each participant. At the end of the experiment participants were required to fill out the anonymous background information sheet.

### 2.3.4 Participants

Seventy-two English (L1) – Māori (L2) bilinguals participated in the short-term auditory lexical decision task. No participant reported any hearing impairment. Thirty-six females and 36 males took part, with an age range of 18–40 (mean=26.2). Subjects were recruited by the snowball method in the cities of Christchurch and Auckland, and all received monetary compensation for their participation. Sixty-seven participants identified themselves as ethnically Māori, two as Samoan, and three as of European descent.

Lexical processing in bilinguals has been found to differ depending on the degree of language proficiency and dominance, age of acquisition (AoA), mode of acquisition, and language use (e.g., Chen, 1992; Kroll and de Groot, 1997; Mo et al., 2005; Li et al., 2009). It is paramount, therefore, to collect this information from subjects participating in bilingual studies. All listeners in our experiment were English language dominant, who self-reportedly use the Māori language between 5-50% in their every day life (mean=17%). The AoA ranged from birth to 35 years of age (mean=11.7), where 8 participants reported to have started learning the Māori language at birth. Thirty-two participants attended some form of total immersion Māori language education programme as a child. Note, however, that these parameters could not be controlled for in this study, and participants were randomly assigned to the nine lists.

Previous research suggests that self-reported language proficiency measures are indicative of linguistic ability, and multiple studies have shown that self-ratings are significantly correlated with objectively measured proficiency (e.g., Marian et al., 2007). In the present study participants were required to report their Māori language proficiency by answering the question *How well are you able to speak Māori in everyday conversation?* on a five point scale:[4]

1. Very well (I can talk about almost anything in Māori)
2. Well (I can talk about many things in Māori)
3. Fairly well (I can talk about some things in Māori)
4. Not very well (I can only talk about simple/basic things in Māori)
5. No more than a few words or phrases.

Participants who responded with *very well* or *well* were grouped together as *advanced* speakers. Subjects responding with *fairly well* and *not very*

[4]These descriptors were trialled and validated by Te Puni Kōkiri (Ministry of Māori Development) (2002) in their Health of the Māori Language surveys conducted in 2001 and 2006.

*well* are reported in this thesis as the *low* proficiency group. No participant chose option 5.

The linguistic experience of participants has repeatedly been shown to affect the perception of dialect variation (e.g., Preston, 1986; Tamasi, 2003; Clopper, 2004). Most of these studies were concerned with regional variation in the United States and demonstrated a correlation between the mobility of listeners and their dialect perception. Linguistic experience does not only play a role in the perception of geographical dialects but also in the perception of ethnic varieties. In New Zealand, Robertson (1994) and Szakay (2008) illustrated that previous linguistic experience influences one's performance in an ethnic dialect categorization task. To gauge the extent to which each participant has been exposed to Māori English, it was necessary to devise a procedure for characterizing social network structure which reflects local social practice. Szakay (2008) designed a Māori Integration Index (MII) based on the social network strength scores previously used in Robertson (1994). The MII is constructed form responses to eight questions presented on the background information sheet (see Appendix Two), and aims to measure participants' level of involvement in the Māori community, and thus, their exposure to Māori English. The distribution of MII scores for the 72 participants in our short-term priming experiment is presented in Figure 2.4. MII scores ranged from 5.5 to 16 (where the possible range is 0 to 17), with a median score of 12. Subjects with a score lower than the median were assigned to the Low MII Group, while subjects with a score equal to or higher than 12 were assigned to the High MII Group for the purpose of analyses using group data. Figure 2.5 shows the distribution of MII according to L2 proficiency. MII scores in the low proficiency group are significantly lower than in the advanced group ($t(65.79)=-1.99$, $p=.049$), suggesting - not surprisingly - that advanced speakers of Māori are more integrated into Māori culture than low proficiency speakers. At the same time the low proficiency group has a wider distribution on the MII scale, which suggests that they can be highly exposed to Māori English but at the same time not be proficient in the Māori language itself.

These language and socio-cultural measures were taken after the experi-

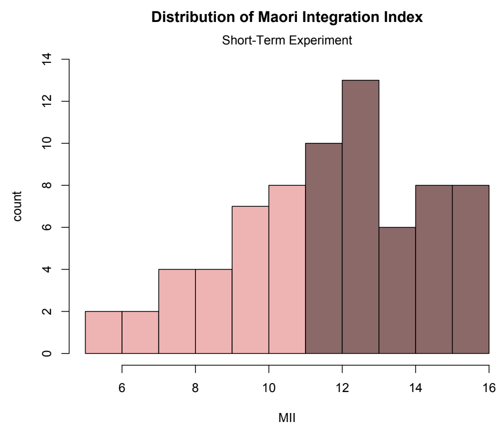


Figure 2.4: Distribution of participants' Māori Integration Index in the short-term experiment.

ment, thus assignment to particular lists were not possible. Table 2.2 shows the number of participants in each condition by trial type and Māori Integration Index. Table 2.3 shows the number of participants in each condition by trial type and L2 proficiency level.

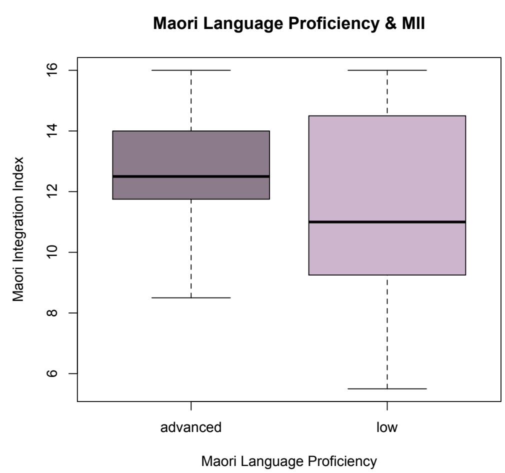


Figure 2.5: Participants' Māori Integration Index and Māori language proficiency level in the short-term experiment.

Table 2.2: The number of participants in each condition by trial type and Māori Integration Index in the short-term experiment.

| | control trials | | critical trials | |
|---|---|---|---|---|
| condition | high-MII | low-MII | high-MII | low-MII |
| ME-ME | 22 | 10 | 21 | 19 |
| ME-PE | 20 | 12 | 23 | 17 |
| ME-TR | 18 | 14 | 25 | 15 |
| PE-ME | 21 | 11 | 22 | 18 |
| PE-PE | 17 | 15 | 26 | 14 |
| PE-TR | 18 | 14 | 25 | 15 |
| TR-ME | 20 | 12 | 23 | 17 |
| TR-PE | 17 | 15 | 26 | 14 |
| TR-TR | 19 | 13 | 24 | 16 |

Table 2.3: The number of participants in each condition by trial type and participants' L2 proficiency levels in the short-term experiment.

| | control trials | | critical trials | |
|---|---|---|---|---|
| condition | advanced | low prof. | advanced | low prof. |
| ME-ME | 15 | 17 | 17 | 23 |
| ME-PE | 14 | 18 | 18 | 22 |
| ME-TR | 12 | 20 | 20 | 20 |
| PE-ME | 13 | 19 | 19 | 21 |
| PE-PE | 10 | 22 | 22 | 18 |
| PE-TR | 17 | 15 | 15 | 25 |
| TR-ME | 16 | 16 | 16 | 24 |
| TR-PE | 14 | 18 | 18 | 22 |
| TR-TR | 17 | 15 | 15 | 25 |

## 2.4 Accuracy Results

Two performance measures were calculated to gauge participants' accuracy in the lexical decision task: percent correct on the one hand, and d' (d-prime) and response bias from signal detection theory on the other. d' is a better measure of overall accuracy than percent correct because it accounts for the relative rates of hits and false alarms (more on these measures in Section 2.4.2). Nevertheless, in order to provide a more intuitively interpretable measure of accuracy, first summary statistics for percent correct scores are presented in Section 2.4.1, followed by d' and response bias scores in Section 2.4.2.

### 2.4.1 Percent Correct

#### Overall Results

Overall, participants performed at an 83% accuracy rate in the lexical decision task. Figure 2.6 shows the average level of accuracy in each of the nine conditions. This figure includes results for both real words and non-words.

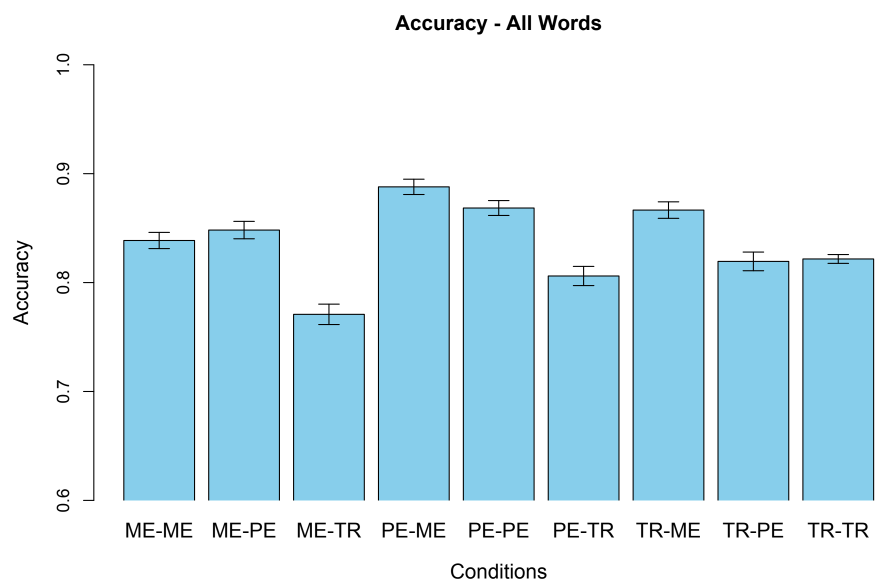


Figure 2.6: Accuracy by condition for all words, including pseudo words.

Not surprisingly, accuracy levels are lower in the bilingual conditions than in the monolingual repetition priming conditions. Participants were least accurate in the L1-L2 conditions (ME-TR 77% and PE-TR 81%), where they had to make lexical decisions on Māori language targets. In the L2-L1 conditions, it seems that participants performed better in the TR-ME condition than in the TR-PE condition. However, closer inspection of the data reveals that this is caused by responses to the pseudo words in the TR-ME condition. In fact, both the TR-ME and PE-ME conditions show high levels of accuracy that are only due to responses to the pseudo words. This will be further discussed in the next section in terms of response bias.

### 2.4.2 Sensitivity and Response Bias

The percentage of correct responses does not provide a full picture of participants' accuracy in a lexical decision task. It is crucial to take into consideration both correct and incorrect responses. One can easily imagine a scenario where a subject consistently presses the *real word* button to each and every target word during the experiment. Using this strategy she would score 100% correct on the real word stimuli, and of course 0% correct on the non-word stimuli. Many studies do not analyze responses given to the pseudo words, and could report that the subject performed at a 100% level of accuracy on the real words, not realizing that she did not even have to listen to the words to achieve this score.

Detection Theory (originally *Signal Detection Theory and Psychophysics* by Green and Swets (1966)) gets around this problem by providing a method that takes into consideration both correct and incorrect responses to create a bias-free estimate of sensitivity to the word/non-word distinction (Macmillan and Creelman, 2005).

The terminology used in Detection Theory is presented in Table 2.4. Correctly recognizing a real word is termed a HIT, while failing to recognize it is a MISS. Mistakenly identifying a pseudo word as a real word is a FALSE ALARM, while correctly identifying it as a non-word is termed a CORRECT REJECTION.

Table 2.4: Detection theory terminology.

| | | RESPONSE | |
|---|---|---|---|
| | | *real word* | *non-word* |
| STIMULUS | *real word* | hit | miss |
| | *non-word* | false alarm | correct rejection |

The measure of sensitivity to the word/non-word distinction is called *d'* (d-prime), and it is computed using the hit rate (H) and the false alarm rate (F). The former is the proportion of *hits* out of all real word trials, while the latter is the proportion of *false alarms* out of all non-word trials. The larger the difference between H and F, the better the subject's sensitivity. The statistic d' is a measure of this difference, and is calculated as the difference between the z-transforms of the hit rate and the false alarm rate:

$d' = z(H) - z(F)$

A high d' score means that the participant readily distinguishes words from non-words. To calculate z-scores, neither H nor F can be 0 or 1. In case of any hit rates of 1, or false alarm rates of 0, a slight adjustment is needed before z-score calculations. The standard correction method – and the one used in this study – is to use F=1/(2N) instead of F=0, where N is the maximum number of false alarms possible. This is basically the same as saying half a false alarm was observed. Similarly, instead of H=1 we can use H=1-1/(2N), where N is the maximum number of possible hits. Corrections had to be made on both false alarms rates and hit rates in this study, and in three instances even a zero hit rate needed to be adjusted.

To complement the d' sensitivity scores it is also useful to calculate a response bias measure, which gauges participants' tendency to respond *real word* or *non-word* in a lexical decision task. The bias measure for detection theory is called *c* (for criterion) and is calculated using the hit rate and the false alarm rate in the following way:

$c = -1/2*(z(H)+z(F))$

The range of *c* is the same as that of *d'*, although 0 is at the centre rather than an endpoint. Based on how hits were defined in this task, a positive bias indicates a tendency for participants to respond *non-word*, while a negative bias indicates a tendency to respond *real word*.

### Overall Results

Figure 2.7 shows d' sensitivity scores for the nine conditions, where high values indicate that participants easily distinguish real words from non-words. An ANOVA shows a significant effect of condition on overall d' values (F(8,639)=7.82, p<.001). The following sections will further analyze potential effects of condition, Māori Integration Index and L2 proficiency on d' values.

The lowest sensitivity scores are found in the ME-TR condition, where participants were required to make lexical decisions on a Māori language target after hearing a Māori English prime (mean=1.79, sd=0.80). Tukey's HSD test shows that sensitivity in the ME-TR condition is significantly lower than in all other conditions with the exception of the PE-TR and TR-PE conditions. The highest sensitivity scores are achieved in the PE-ME condition, where participants make lexical decisions on Māori English targets after hearing a standard Pākehā English prime (mean=2.56, sd=0.69). However, this condition is also one of the two conditions exhibiting a positive response bias (see Figure 2.8). Tukey's HSD test shows that sensitivity in the PE-ME condition is only significantly greater than in the three lowest d' conditions: ME-TR, PE-TR, and TR-PE.

Another ANOVA was run with response bias as the dependent variable, which also showed a significant effect of condition (F(8,639)=24.73, p<.001). This will be further analyzed in the following sections. Figure 2.8 shows that the PE-ME and TR-ME conditions are the only ones showing a positive bias, that is, in these conditions participants had a bias to respond non-word. Bias scores in both of these conditions are significantly larger than zero (PE-ME: t(71)=2.37, p=0.02; TR-ME: t(71)=3.31, p=0.001). A potential explanation for this has to do with the Māori English male speaker producing the ME targets, who has a strong ME accent that is very different from the

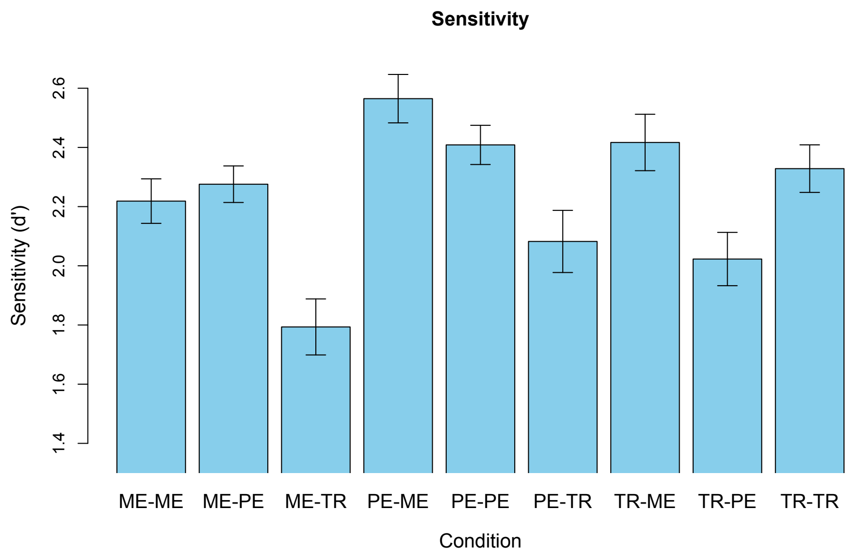


Figure 2.7: Sensitivity scores by condition. A high d' score means that participants readily distinguish real words from non-words.

standard PE variety. It is likely that participants in a formal experimental environment are perplexed to hear such a non-standard accent, and tend to identify his real words as non-words in English. The exception to this is when the ME targets are preceded by a ME prime produced by the Māori English female speaker. In this condition, having just been exposed to a ME prime helps participants to identify the male ME speaker's real words as existing English words. Chapter 3 presents a Māoriness rating experiment, which shows that the Māori English male speaker is rated highly on the Māoriness scale.

The largest negative response bias was found in the TR-TR condition (mean=0.56, sd=0.41). Tukey's HSD test reveals that bias scores in this condition are significantly different from all other conditions (except the ME-TR condition). That is, participants have a tendency to respond with real words in this condition, where both prime and target are in the Māori language. A possible explanation for this is that when a learner hears an L2

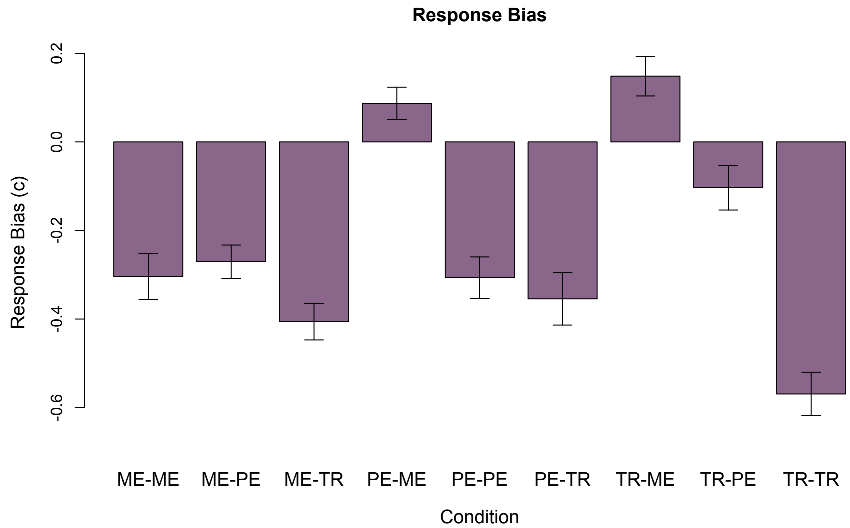


Figure 2.8: Response bias by condition. A positive bias indicates a tendency to respond *non-word*. A negative bias indicates a tendency to respond *real word*.

word for the first time, he might assume that it is a real word in the L2, but one that he has not yet acquired. This would especially be the case when the word in question obeys the phonotactic rules of the L2, like all pseudo words did in this experiment.

The following sections investigate what effect participants' Māori Integration Index and L2 proficiency have on sensitivity and bias scores in the various conditions. ANOVAs were conducted on the data to examine the effects of Māori Integration Index and L2 proficiency on sensitivity and response bias scores, with `d'` and `c` as the dependent variables respectively, and `Māori Integration Index` (high and low), `L2 proficiency` (advanced and low), and `condition` as predictors.

### Bilingual Conditions

First the bilingual conditions are analyzed, which include the L1-L2 conditions (ME-TR and PE-TR), and the L2-L1 conditions (TR-ME and TR-

PE). An ANOVA was run with `d'` as the dependent variable. The independent variables included `condition` (ME-TR, PE-TR, TR-ME, TR-PE), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low). A main effect of condition was found (F(3,256)=2.74, p=.004), which allowed us to further investigate potential significant effects on sensitivity scores within the L1-L2 conditions (ME-TR and PE-TR) and the L2-L1 conditions (TR-ME and TR-PE) separately. A second ANOVA investigated response bias as the dependent variable, while the independent variables included `condition` (ME-TR, PE-TR, TR-ME, TR-PE), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low). A significant main effect of condition was found (F(3,256)=6.18, p<.001).

**Sensitivity in the L1-L2 conditions.** The L1-L2 conditions include ME-TR and PE-TR, where participants made lexical decisions on Māori language target words. The ANOVA included `d'` as the dependent variable, and `condition` (ME-TR, PE-TR), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low) as independent variables. The results revealed a significant main effect of L2 proficiency (F(1,132)=13.46, p<.001). This is shown in Figure 2.9, illustrating that advanced proficiency participants are significantly better at distinguishing real Māori words from non-words in both of the L1-L2 conditions. Condition itself had no significant effect, indicating that the difference in d' scores previously seen in Figure 2.7 is not statistically significant between the PE-TR and the ME-TR conditions.

**Response bias in the L1-L2 conditions.** Although both ME-TR and PE-TR conditions exhibit a negative response bias (ME-TR: t(71)=-5.98, p<.001; PE-TR: t(71)=-9.87, p<.001), where participants have a real word bias on Māori language targets, there were no significant effects of condition, MII or L2 proficiency on response bias in these two conditions, where the dependent variable was `c`, and the predictors in the ANOVA model were `condition` (ME-TR, PE-TR), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low).

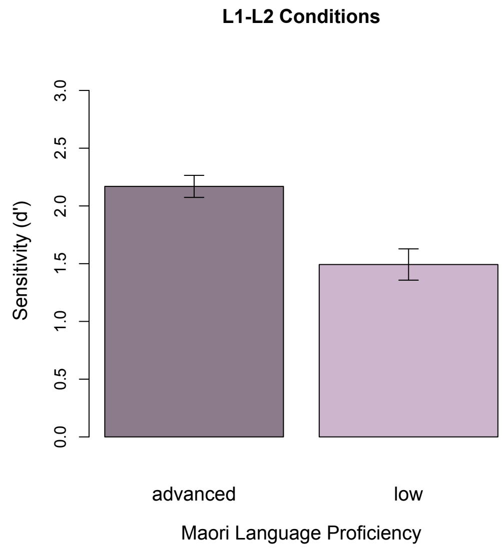


Figure 2.9: L1-L2 Conditions - main effect of proficiency. A high d' score means that participants readily distinguish real words from non-words.

**Sensitivity in the L2-L1 conditions.** In these two conditions participants made lexical decisions on English target words, preceded by a Māori language prime word. The ANOVA included sensitivity as the dependent variable, and and `condition` (TR-ME, TR-PE), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low) as independent variables. The results revealed significant main effects of condition (F(1,132)=4.23, p<.05), and Māori Integration Index (F(1,132)=4.26, p<.05). Following a Māori language prime, participants are better at distinguishing Māori English real words from non-words than Pākehā English real words and non-words. Participants with a high Māori Integration Index perform better at the task than the low MII group. Figure 2.10 illustrates these two main effects. There was no effect of L2 proficiency on sensitivity in these two conditions.

**Response bias in the L2-L1 conditions.** Another ANOVA with `response bias` as the dependent variable, and `condition` (TR-ME, TR-PE), `Māori`

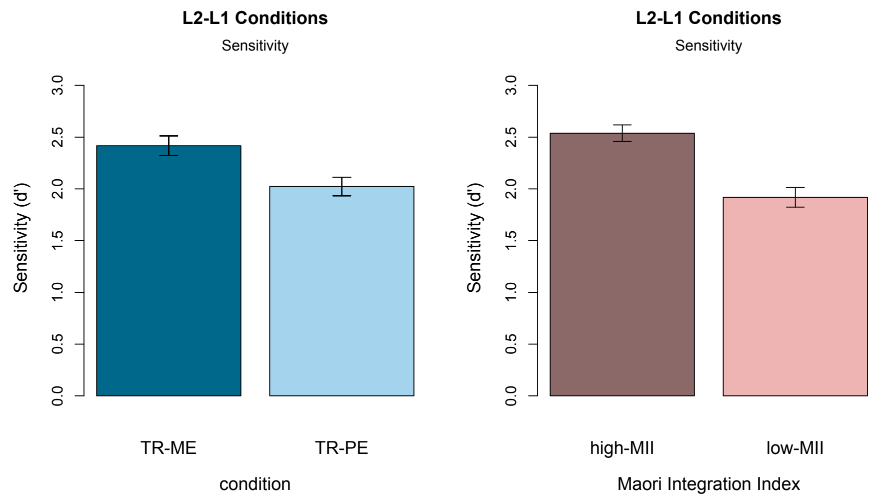


Figure 2.10: L2-L1 d' - main effects of condition and MII. A high d' score indicates that participants readily distinguish real words from non-words.

`Integration Index` (high or low), and `L2 proficiency` (advanced or low) as independent variables, revealed a significant main effect of condition in the L2-L1 analysis (F(1,132)=5.36, p=.002). Participants are significantly more likely to respond *non-word* on the Māori English targets than on the Pākehā English targets. This is shown in Figure 2.11.

**English Language Conditions**

Analyses of sensitivity and response bias were also run in the English-only conditions, with with `d'` and `c` as the dependent variables respectively, and `Māori Integration Index` (high and low), and `condition` (ME-ME, PE-ME and PE-PE, ME-PE) as predictors. The ANOVA of sensitivity revealed no effects of condition, or any other independent variable. However, the ANOVA of response bias showed a significant main effect of condition (F(3,256)=4.26, p=.006). Further analysis of response bias is given below.

**Response bias in the Māori English target conditions.** A separate ANOVA was run on the two Māori English target conditions. The depen-

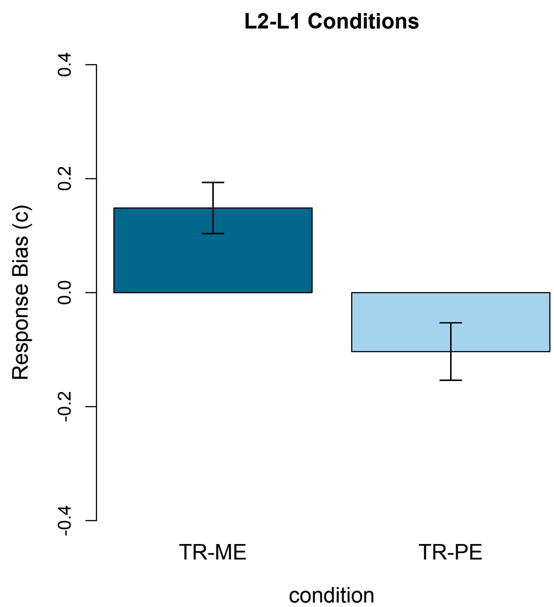


Figure 2.11: L2-L1 bias - main effect of condition. A positive bias indicates a tendency to respond *non-word*. A negative bias indicates a tendency to respond *real word*.

dent variable was `response bias`, and `Māori Integration Index` (high and low), and `condition` (ME-ME, PE-ME) were the predictors. There was a significant effect of condition on response bias in the Māori English target conditions (F(1,136)=9.66, p=.002), shown in Figure 2.12. Participants are significantly more likely to have a positive bias - that is misidentify real words as non-words - in the cross-dialect PE-ME condition than in the within-dialect ME-ME condition. Recall from Figure 2.8, that of the three conditions with ME targets, ME-ME was the only one not exhibiting a positive response bias. That is, if the Māori English target is preceded by a Māori English prime, participants do not show a tendency to misidentify real words as non-words.

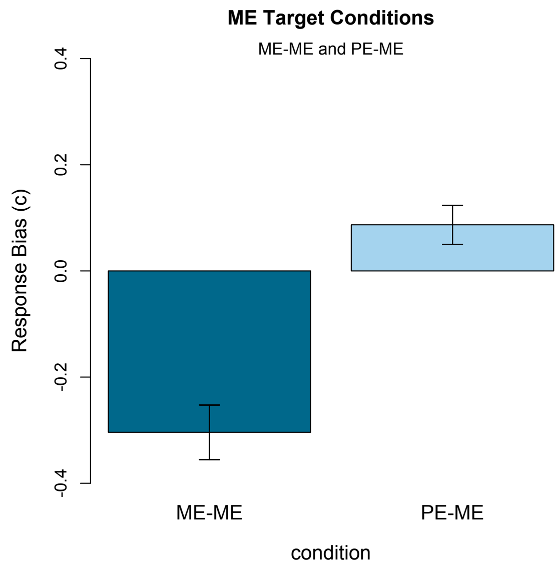


Figure 2.12: ME target conditions - response bias by condition. A positive bias indicates a tendency to respond *non-word*. A negative bias indicates a tendency to respond *real word*.

**Response bias in the Pākehā English conditions.** There were no significant effects of MII, L2 proficiency, and condition on response bias values in the PE-PE and ME-PE conditions.

### Māori Language Condition

In this condition participants were required to make lexical decisions on Māori language targets after hearing a Māori language prime. Two ANOVAs were run, one with `sensitivity`, and one with `response bias` as the dependent variable. The independent variables included participants' `L2 proficiency` (advanced and low) and `Māori Integration Index` (high and low).

**Sensitivity in the Māori language condition.** The ANOVA revealed a significant effect of L2 proficiency on d' scores ($F(1,66)=4.85$, $p<.05$).

Advanced speakers of Māori perform significantly better than low proficiency participants in this task. Figure 2.13 plots this main effect.

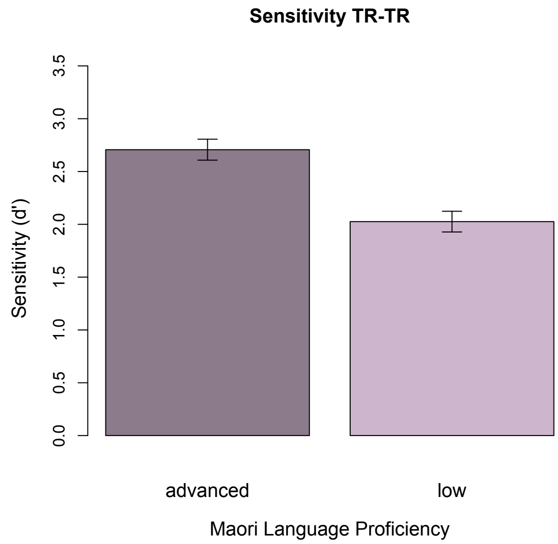


Figure 2.13: TR-TR condition - sensitivity by MII and L2 proficiency. A high d' score indicates that participants readily distinguish real words from non-words.

**Response bias in the Māori language condition.** There were no significant effects of MII or L2 proficiency on response bias in the TR-TR condition. However, recall from Figure 2.8 that it is this condition that exhibits the largest negative response bias. That is participants are most likely to misidentify non-words as real words in this Māori language only condition.

### 2.4.3 Summary of Accuracy Results

Participants' accuracy in the short-term lexical decision task can be significantly affected by the test condition, as well as their Māori Integration Index, and level of Māori language proficiency. In those conditions where a lexical decision is to be made on a L2 Māori language target word we see a consistent effect of Māori language proficiency. Advanced speakers of Māori are significantly more accurate at distinguishing real Māori words from non-words.

Being highly integrated into the Māori community - hence having a high exposure to the Māori English variety - also proves to be beneficial. A high MII score improves sensitivity in the L2-L1 conditions, where the lexical decision is made on both Māori English and Pākehā English words followed by a Māori language prime.

Response bias scores were not affected by participants' Māori Integration Index or L2 proficiency levels in any condition. However, significant differences were seen between the conditions. Particularly interesting, is the two of the nine conditions that exhibit a significant positive response bias, namely PE-ME and TR-ME. Participants - regardless of MII or proficiency levels - tend to misidentify Māori English real words and non-words, when those targets are preceded by a Pākehā English prime or a Māori language prime. The only condition that does not show this positive response bias on a ME word is when the ME target is preceded by a Māori English prime. In other words, having just been exposed to a within-dialect prime facilitates the identification of real ME target words as existing English words.

This section investigated the ways different language varieties can affect decision making processes in a lexical decision task. The next section examines the time-course of the correct decisions made by participants.

## 2.5 Reaction Time Results

### 2.5.1 Analysis

The reaction time analysis was carried out on the critical and control trials, using accurate lexical decision responses only. Outliers over 2.5 SD away from the mean were removed in each of the nine conditions to obtain a normal distribution of reaction times. This equalled 2.39% of the total data.

Recall from Section 2.3.2, that no participant heard any item, variant of an item, or the translation equivalent of an item more than once. This was done to ensure that target words do not get primed by more than one item during the experiment. Due to the nature of this design, it is not possible to compute priming values for each target word within an individual participant. Rather, an across-subject analysis is needed.

To establish whether significant priming was achieved ANOVAs were run on the data with `reaction time` as the dependent variable. The independent variables included `condition`, `trial type` (control or critical), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). In case of significant results Tukey's Honestly Significant Difference (HSD) was used as a post-hoc multiple comparisons test.

Significant priming is observed in a condition if we obtain an effect or `trial type` in the analysis. In other words, if reaction times are significantly faster on related critical trials than on unrelated control trials, then translation priming is achieved.

### 2.5.2 Overall Results

Figure 2.14 provides a graphical overview of response times to related critical trials and unrelated control trials within the nine experimental conditions. In this figure, and all figures in the following sections dark coloured bars always represent the control trials, while light coloured bars represent the related, critical trials. A quick and easy way to gauge whether significant priming might be observed in a condition is to check the difference between the dark and light bars. A large difference indicates that the priming value is probably significant.

The following sections statistically analyze the response times in all of the nine conditions, and investigate any potential effects of trial type, condition, Māori Integration Index, and level of L2 proficiency. I start with the bilingual conditions in Section 2.5.3, followed by the English-only conditions in Section 2.5.4. Finally, I look at the Māori language condition in Section 2.5.5.

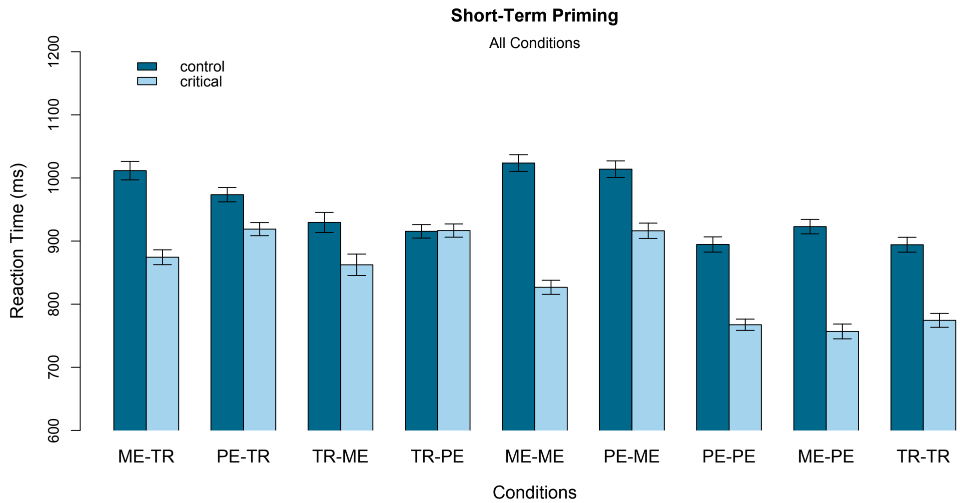


Figure 2.14: Mean reaction times and standard error values for all conditions.

### 2.5.3 Bilingual Conditions

An ANOVA was run on the bilingual data with `reaction time` as the dependent variable. The independent variables included `trial type` (control or critical), `condition` (ME-TR, PE-TR, TR-ME, TR-PE), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low). A main effect of condition was found (F(3,2184)=6.071, p<.001), which allowed us to further investigate potential significant effects on reaction times within the L1-L2 conditions (ME-TR and PE-TR) and the L2-L1 conditions (TR-ME and TR-PE) separately.

#### L1-L2 Conditions

As a next step an ANOVA was run on the L1-L2 data, again with `reaction time` as the dependent variable. The independent variables included `trial type` (control or critical), `condition` (ME-TR, PE-TR), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). Now it was also possible to include the `prime variable` as an independent predictor with the following four levels: final-z, GOAT, GOOSE, and θ. The results revealed main effects of trial type (F(1,1093)=65.31, p<.001) and L2 proficiency (F(1,1093)=7.59, p<.01), with both of these predictors also showing up in significant interactions.

A significant interaction was found between condition and trial type (F(1,1093)=9.52, p<.01), which is shown in Figure 2.15. A post-hoc analysis using Tukey's HSD reveals that significant priming was obtained in both L1-L2 conditions, meaning that reaction times to ME-TR critical pairs were significantly faster than to ME-TR control pairs (p<.001), and similarly, reaction times to PE-TR critical pairs were significantly faster than to PE-TR control pairs (p<.001). The post-hoc analysis also shows that there is no significant difference between the reaction times to ME-TR control pairs and PE-TR control pairs (the two dark coloured bars in the figure), however, reaction times to the ME-TR critical pairs are significantly faster than to PE-TR critical pairs (the two light coloured bars in the figure) (p= 0.025).

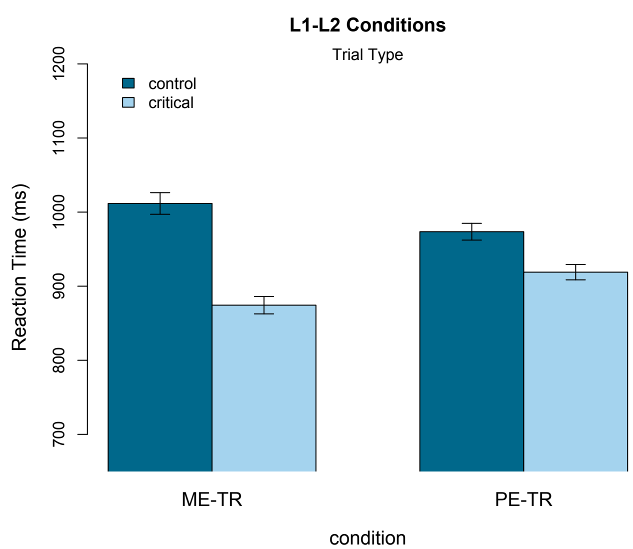


Figure 2.15: L1-L2 conditions - interaction of condition and trial type.

A significant interaction was found between condition and the sociophonetic variable contained in the English prime word (F(3,1093)=3.77, p=.0103). This is shown in Figure 2.16. Post-hoc analysis reveals that words containing the GOAT vowel get a significantly faster response in the ME-TR condition than words containing the other variables (p=0.021). However, in the PE-TR condition, where the prime is in Pākehā English, the GOAT vowel is not behaving differently from the other variables. In other words, hearing a Māori English prime word that contains the GOAT vowel facilitates processing of a Māori language target word, while the Pākehā English GOAT primes do not show this facilitative effect.

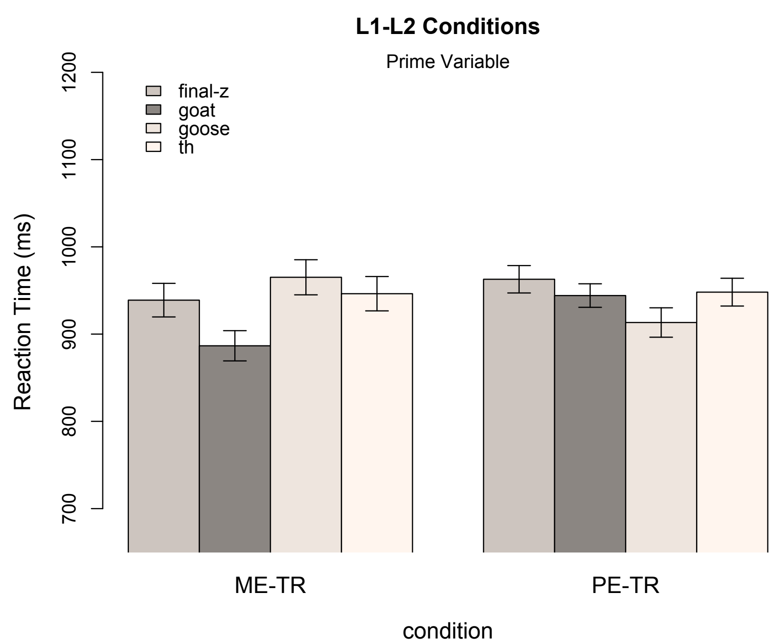


Figure 2.16: L1-L2 conditions - interaction of condition and prime variable.

The results also revealed a significant three-way interaction between trial type, condition, and the Māori Integration Index of the participant (F(1,1093)=3.10, p<.05), as demonstrated in Figure 2.17. In the PE-TR condition, where the prime is in Pākehā English, participants' level of integration into Māori culture does not distinguish between reaction times to

Māori language control and critical pairs. However, in the ME-TR condition, where the prime is in Māori English, a high MII score facilitates processing of critical pairs. This is evidenced by significantly faster response times to the critical items by high MII participants than by low MII participants (Tukey's HSD, p=.043). Reaction times to the control pairs do not significantly differ across the two conditions, and the two MII groups.

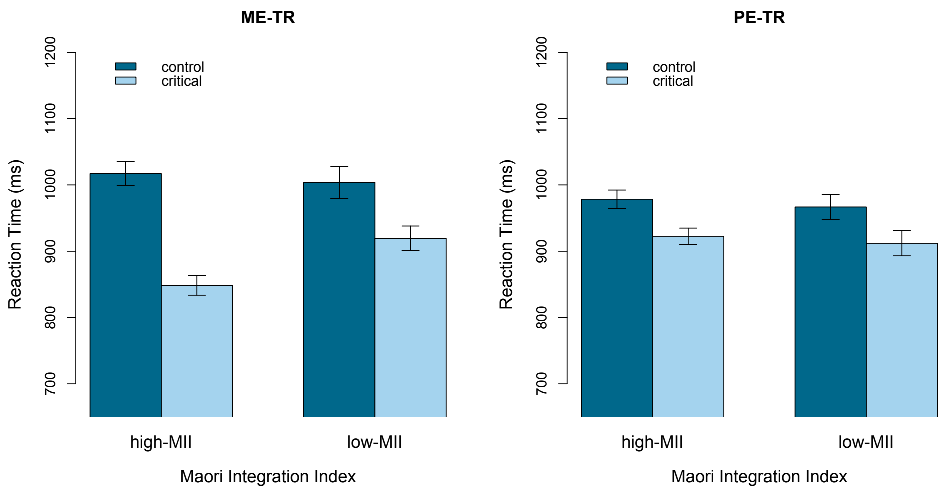


Figure 2.17: L1-L2 conditions - interaction of type, condition, and MII.

A significant three-way interaction was also revealed between trial type, condition and Māori language proficiency (F(1,1093)=4.61, p<.05), which is shown in Figure 2.18. There were no significant differences in reaction times to the critical trials across the two conditions, and the two proficiency groups. However, the low proficiency participants in the ME-TR condition take significantly longer to respond to control trials than do the advanced proficiency group (Tukey's HSD, p=.034). L2 proficiency has no such effect in the PE-TR condition, where there is no significant difference between reaction times to the control trials across the two proficiency groups.

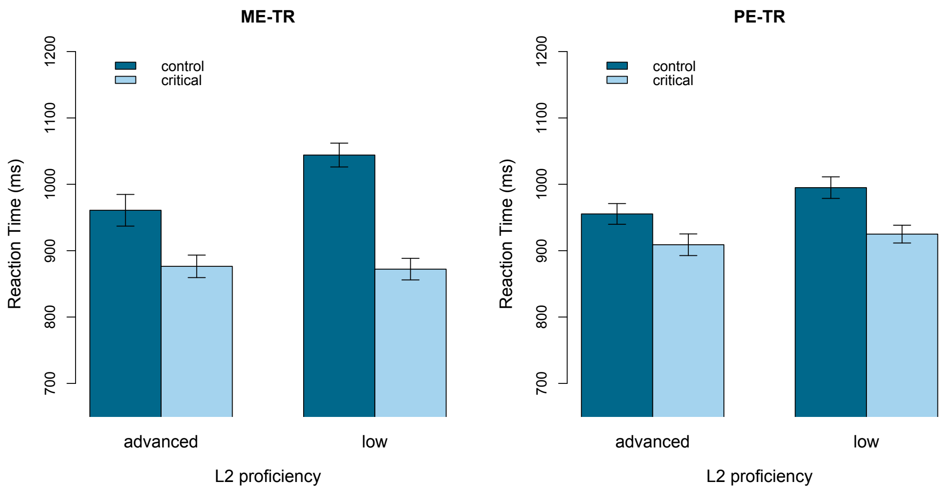


Figure 2.18: L1-L2 conditions - interaction of type, condition, and L2 proficiency.

### L2-L1 Conditions

A separate ANOVA was run in the L2-L1 conditions, where participants were required to make lexical decisions on English target words preceded by Māori prime words. In this analysis the dependent variable was again `reaction time`, and it was possible to include the `target variable` as one of the independent variables, with its four levels: final-z, GOAT, GOOSE, and θ. The other predictor variables were `trial type` (control or critical), `condition` (TR-ME, TR-PE), participants' `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). The results show a main effect of trial type (F(1,1019)=5.75, p=.017) and target variable (F(3,1019)=13.68, p<.001), both of which are present in significant interactions as well.

Similarly to the L1-L2 analysis, the results revealed a significant interaction of trial type and condition in the L2-L1 data as well (F(1,1019)=7.56, p<.01). This is shown in Figure 2.19. A post-hoc analysis indicates significant priming in the TR-ME condition, where critical trials get a significantly faster response than unrelated, control trials (Tukey's HSD, p=.005). However, no priming is obtained in the TR-PE condition, where the prime is in the L2 and the target word is in the mainstream English dialect. In other words, the processing of a Māori target word is facilitated by a Māori English prime, but not by a Pākehā English prime.

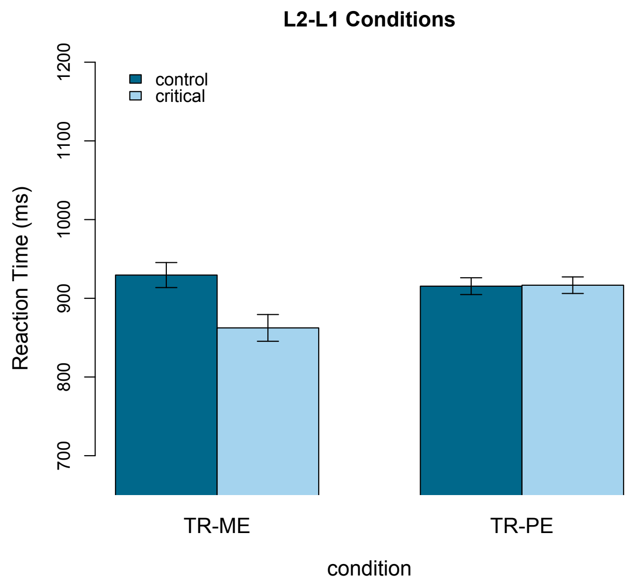


Figure 2.19: L2-L1 conditions - interaction of trial type and condition.

We saw a significant three-way interaction of condition, trial type, and Māori Integration Index in the L1-L2 conditions. In a similar fashion the interaction of the same three variables shows up as significant in the L2-L1 conditions as well (F(1,1019)=7.00, p<.01). There is no significant priming obtained in the TR-PE condition, which is indicated by the lack of significant difference in reaction times to critical and control pairs, regardless of participants' level of integration into Māori culture. In the TR-ME condition, however, there is significant priming for the high MII participants, who respond to critical pairs significantly faster than to control pairs (Tukey's HSD, p=0.005). There is no such facilitation for participants with low MII scores. In other words, a Māori language prime facilitates the processing of Māori English targets only for those individuals who are highly integrated into Māori culture. Māori language primes do not facilitate the processing of Pākehā English words for any participant. This is shown in Figure 2.20.

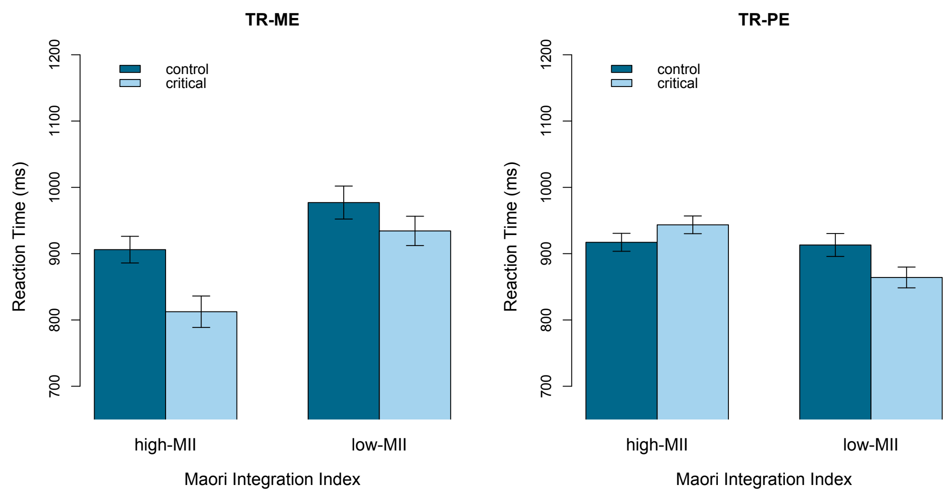


Figure 2.20: L2-L1 conditions - interaction of condition, type, and MII.

The results of the ANOVA reveal another significant three-way interaction, that of condition, trial type, and the phonetic variable in the target word (F(3,1019)=3.31, p=.019). The only variable that shows significant priming in the L2-L1 conditions is the GOAT vowel in the TR-ME condition (Tukey's HSD, p=<.001). That is, a Māori language prime facilitates the processing of a Māori English translation equivalent if that ME target word contains the innovative GOAT vowel. Crucially, there is no such facilitation for Pākehā English GOAT vowels in the TR-PE condition, as seen in Figure 2.21. Tukey's post-hoc comparison also shows that the control and critical trials do not significantly differ for items containing the Pākehā English GOOSE vowel (Tukey's HSD, p=.97).

Recall that in the L1-L2 conditions there was also an interaction between prime variable and condition, where the GOAT vowel also facilitated processing. However, in the L1-L2 analysis there was no interaction with trial type (as previously seen in Figure 2.16). This indicates that a Māori English prime containing the GOAT vowel facilitates the processing of a Māori lan-

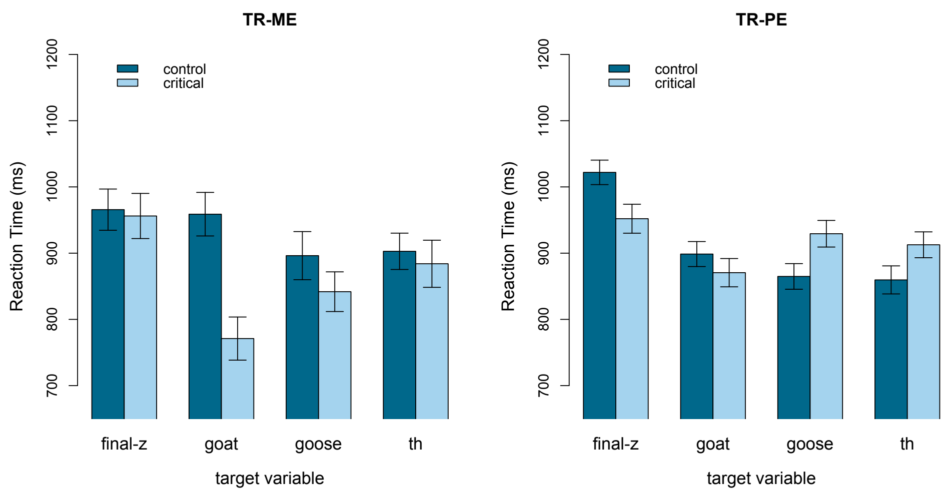


Figure 2.21: L2-L1 conditions - interaction of condition, type, and target variable.

guage target in both critical and control trials, regardless of whether the prime and target are translation equivalents or not. Here in the L2-L1 condition, however, the processing of a Māori English word containing the GOAT vowel is only facilitated in the critical trials. This means that facilitation occurs only when the L2 prime and L1 target are translation equivalents.

### 2.5.4 English Language Conditions

Four of the nine conditions used in the priming experiment are within-English conditions, that is, they have no Māori language component. Critical pairs in these conditions consist of repeated English words, while the control pairs consist of unrelated English lexical items. Two of these English-only conditions are within-dialect (ME-ME and PE-PE), while two are cross-dialect conditions (ME-PE and PE-ME). First an ANOVA was run on the combined data in all four conditions. This showed a significant main effect of condition ($F(1,2310)=65.24$, $p<.001$), which allowed us to further investigate reaction time differences in the different conditions.

**Māori English Target Conditions**

Next an ANOVA was conducted in the two conditions where participants were required to make lexical decisions on Māori English target words: the ME-ME within-dialect condition, and the PE-ME cross-dialect condition. The dependent variable was `reaction time`, while independent variables included `target variable` (final-z, GOAT, GOOSE, and θ), `trial type` (control or critical), `condition` (ME-ME, PE-ME), and participants' `Māori Integration Index` (high or low). All of these four independent variables showed up as significant main effects (trial type: $F(1,1112)=147.16$, $p<.001$, condition: $F(1,1112)=13.88$, $p<.001$, MII: $F(1,1112)=16.24$, $p<.001$, target variable: $F(3,1112)=6.93$, $p<.001$), but all also participated in significant interactions.

The ANOVA showed a significant interaction between trial type and condition ($F(1,1112)=15.07$, $p<.001$), which is illustrated in Figure 2.22. Post-hoc analyses reveal that there is significant priming in both ME-ME and PE-ME conditions, that is, reaction times to critical pairs are significantly faster than to control pairs both in the ME-ME condition (Tukey's HSD, $p<.001$), and the PE-ME condition (Tukey's HSD, $p<.001$). The post-hoc Tukey-tests also reveal that reaction times to the control pairs across the two conditions do not differ, but reaction times to the critical pairs are significantly faster in the within-dialect ME-ME condition than in the cross-dialect PE-ME condition (Tukey's HSD, $p<.001$). In other words, the dialect of the prime word significantly affects the processing of the Māori English target words for critical, repetition trials.

A significant interaction of condition and target variable was also revealed by the ANOVA ($F(3,1112)=9.94$, $p<.001$), which is shown in Figure 2.23. In the PE-ME cross-dialect condition none of the phonetic variables stand out, however, in the ME-ME within-dialect condition the GOAT vowel facilitates lexical processing, significantly more than the other variables (Tukey's HSD, $p<.001$). The lack of an interaction with trial type indicates that the processing of the GOAT vowel is facilitated in both critical and control trials. That is, prime and the target need not be lexically

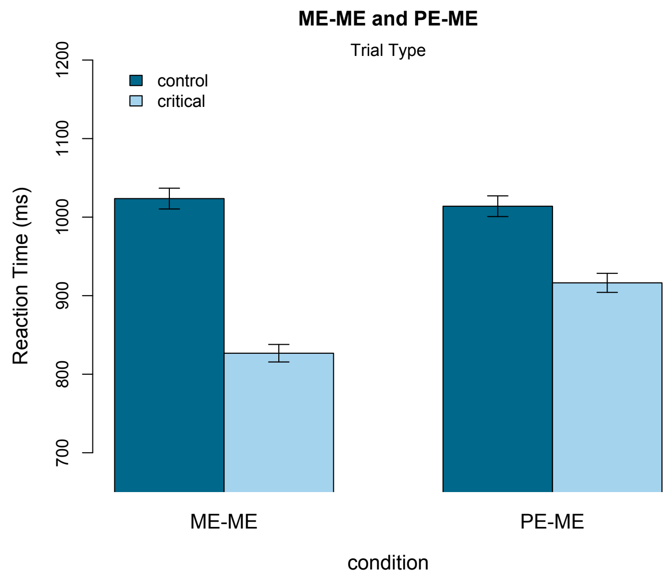


Figure 2.22: ME target conditions - interaction of trial type and condition.

and conceptually related for the GOAT facilitation to occur. This result is reminiscent of the behaviour of the GOAT vowel as a prime variable in the L1-L2 bilingual conditions, as was previously seen in Figure 2.16.

A significant three-way interaction was observed between trial type, condition, and participants' Māori Integration Index ($F(1,1112)=4.09$, $p=.048$) as shown in Figure 2.24. In both conditions reaction times to critical trials were significantly faster than to control trials (Tukey's HSD, $p<.001$), with the exception of the low MII group in the PE-ME condition. Having a high Māori Integration Index facilitates priming of Māori English targets in both conditions, but particularly so in the ME-ME condition. Here high MII participants respond to critical targets significantly faster than the high MII group in the PE-ME condition (Tukey's HSD, $p<.001$). Reaction times to control trials by the high MII group do not differ across the two conditions.

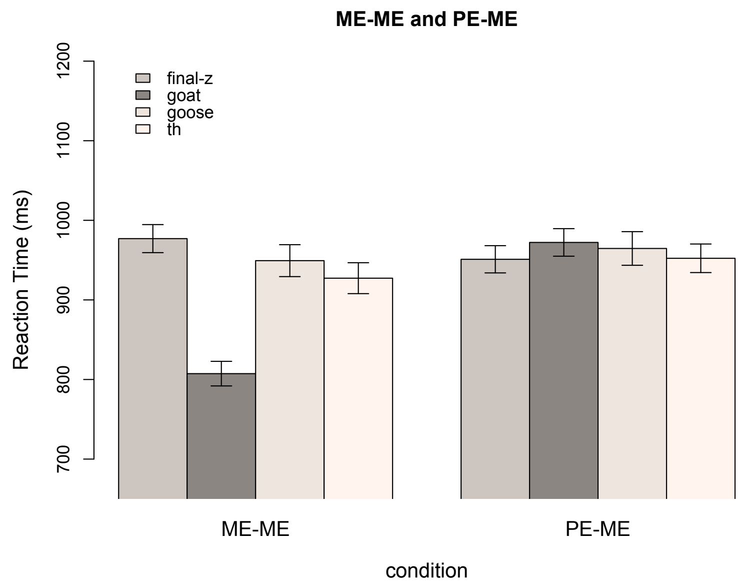


Figure 2.23: ME target conditions - interaction of condition and target variable.

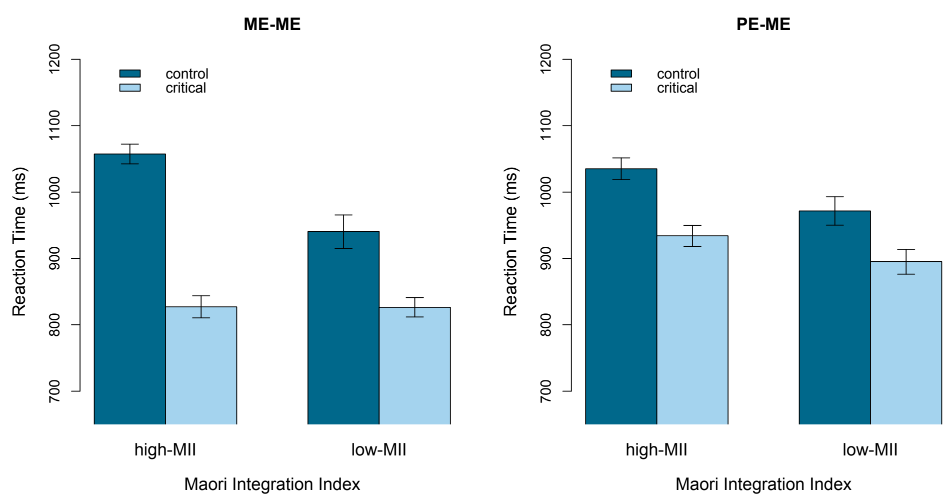


Figure 2.24: ME target conditions - interaction of trial type, condition and MII.

### **Pākehā English Target Conditions**

Another ANOVA was run in the two conditions where participants made lexical decisions on Pākehā English targets, either following a Pākehā English prime (PE-PE), or a Māori English prime (ME-PE). Again, the dependent variable was `reaction time`, while independent variables included `target variable` (final-z, GOAT, GOOSE, and θ), `trial type` (control or critical), `condition` (PE-PE, ME-PE), and participants' `Māori Integration Index` (high or low). Significant main effects were found MII ($F(1,1112)=24.42$, $p<.001$), as well as for trial type ($F(1,1150)=180.79$, $p<.001$). Although condition and target variable were not significant main effects alone, they do participate in significant interactions with other variables.

The ANOVA in these two conditions revealed a significant three-way interaction of condition, trial type and target variable ($F(3,1150)=3.33$, $p=.018$), which is shown in Figure 2.25. In the PE-PE condition, where both the prime and target are in the standard Pākehā English variety, all four variables contribute to significant priming (Tukey's HSD, GOOSE: $p<.05$; final-z, θ, and GOAT: $p<.001$). In the ME-PE cross-dialect condition, however, Pākehā English targets containing the GOAT vowel do not get significantly primed by a Māori English item. In fact Tukey tests reveal that the only variable that does not facilitate priming of a PE target is the GOAT vowel in the ME-PE condition (Tukey's HSD, $p=.97$).

A significant three-way interaction was observed between trial type, condition, and participants' Māori Integration Index ($F(3,1150)=3.30$, $p=.045$) as shown in Figure 2.26. Post-hoc analyses reveal that all participants - regardless of their degree of Māori integration - respond faster to critical trials than to control trials, in both PE-PE and ME-PE conditions. In other words, there is significant priming in both conditions, and from both high and low MII groups. However, the difference between the two groups shows when it comes to responses to the critical items. In both conditions the low integration participants respond faster to the PE targets than the high MII group. Having a low integration index is particularly beneficial for processing a PE target when preceded by a PE prime even when the

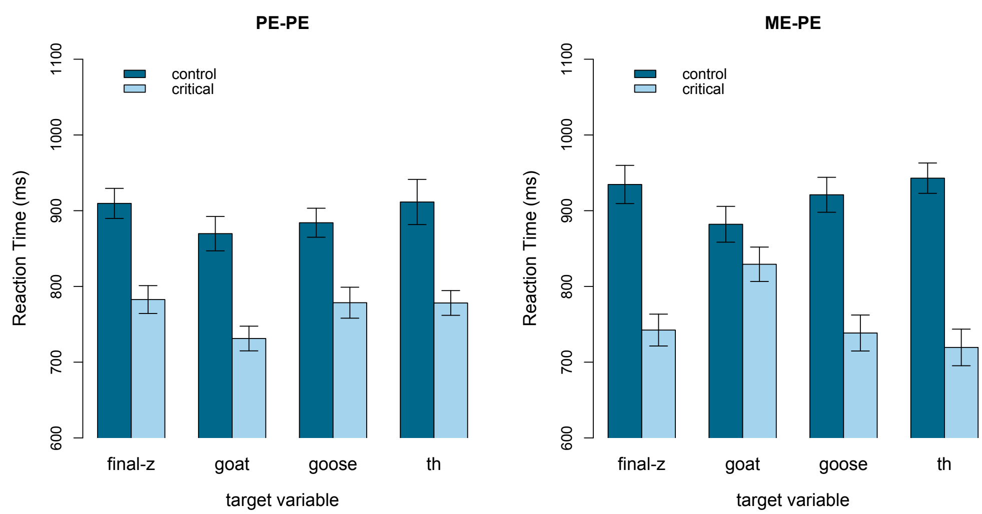


Figure 2.25: PE target conditions - interaction of condition, trial type and target variable.

prime is unrelated. This is shown by the low MII group's reaction times to the control pairs in the PE-PE condition, which are significantly faster than responses to all other control pairs (Tukey's HSD, $p<.001$).

### 2.5.5 Māori Language Condition

The last ANOVA in the short-term experiment was run in the TR-TR condition, which is a L2 repetition priming condition. Critical pairs consist of repeated Māori lexical items, while control pairs are made up of unrelated Māori words. The dependent variable was `reaction time`, while independent variables included `trial type` (critical or control), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). Condition is not included, as we are dealing with one condition only. Prime and target variables are also excluded, as there are no English items in this condition.

The results revealed a main effect of L2 proficiency ($F(1,600)=5.22$, $p<.05$). This is shown in Figure 2.27, illustrating that overall the low proficiency Māori speakers take significantly longer to make a lexical decision

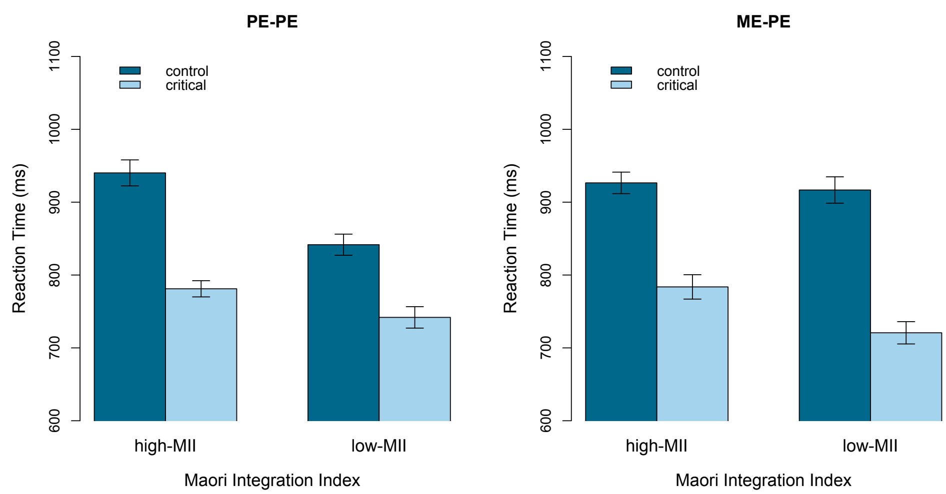


Figure 2.26: PE target conditions - interaction of condition, trial type and MII.

on a Māori target than the advanced Māori speakers do.

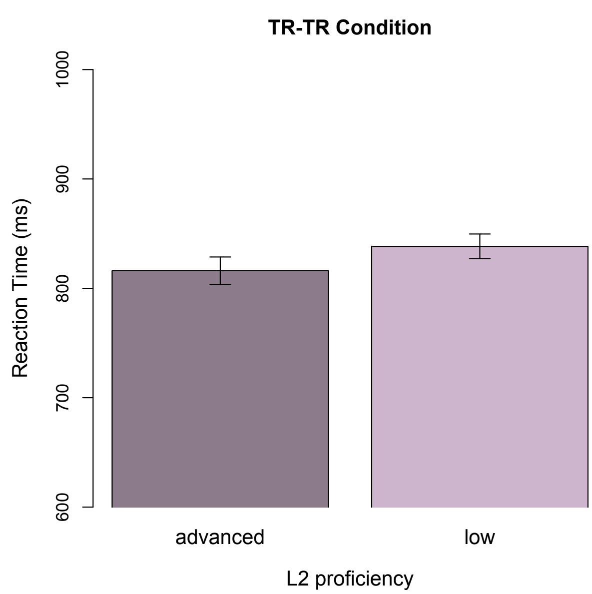


Figure 2.27: TR-TR condition - main effect of L2 proficiency.

Trial type shows up as a main effect (F(1,600)=55.97, p<.001), but also in an interaction with participants' Māori Integration Index (F(1,600)=10.34, p=.0013). This is shown in Figure 2.28. Post-hoc Tukey tests reveal that participants with a high level of integration into Māori culture respond significantly faster to critical trials than to control trials (Tukey's HSD, p<.001), but low MII participants do not. In other words, we only get significant within-Māori repetition priming for the highly integrated group, while the low integration group only reaches near significance (Tukey's HSD, p=.082).

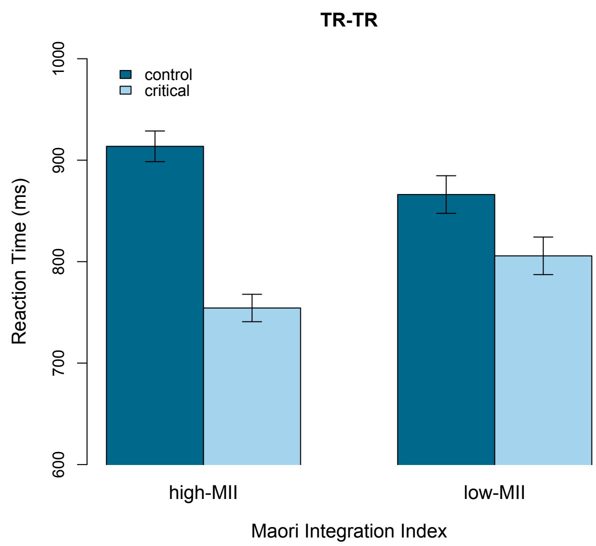


Figure 2.28: TR-TR condition - interaction of trial type and MII.

### 2.5.6 Summary of Results

In the short-term experiment significant priming was obtained in eight of the nine conditions. The only condition where reaction times were not significantly faster to critical trials than to control trials is one of the L2-L1 conditions, where the primes were in the Māori language and the targets were in the Pākehā English variety (TR-PE). In the L1-L2 conditions we saw significant priming in both ME-TR and PE-TR conditions. However, the magnitude of priming was larger in the Māori English to Māori condition than in the Pākehā English to Māori condition.

The GOAT vowel proved to have a special role in processing. It is the most facilitative of the four sociophonetic variables in the ME-TR condition, however it does not behave differently from the other variables in the PE-TR condition. Similarly, the GOAT vowel also facilitated processing in the L2-L1 Māori to Māori English condition. However, there is a crucial difference between the cases of GOAT facilitation in the ME-TR and TR-ME conditions. In the L1-L2 Māori English to Māori condition the prime containing the GOAT vowel facilitates the processing of a Māori language target in both critical and control trials, regardless of whether the prime and target are translation equivalents or not. In the L2-L1 TR-ME condition, however, the GOAT vowel is only facilitative for the critical targets, that is, when the prime and target are conceptually related.

Participants' Māori Integration Index also plays a crucial role in bilingual lexical processing. A high integration score facilitates processing in the ME-TR condition, but not in the PE-TR condition. It plays an even bigger role in L2-L1 processing, where in fact it is only the highly integrated people who show significant priming, and only in the TR-ME condition. The Māori Integration Index also had a significant effect on d' results in addition to the reaction time results. In the L2-L1 conditions, participants were more sensitive in the TR-ME condition than in the the TR-PE condition. However, it was the high MII participants in particular, who showed a significantly greater sensitivity in both L2-L1 conditions, regardless of the ethnic dialect of the English target words. The d' results suggest that there are L2-L1 connections for both dialects, while the reaction time results indicate a facilitative temporal component in processing which more readily connects Māori and Māori English.

Overall, we also saw an effect of L2 proficiency, in that low proficiency Māori speakers take longer to make lexical decisions on Māori language target words than the advanced proficiency speakers. In the within Māori condition, response times were also affected by MII scores, where it was the highly integrated individuals who achieved significant priming.

Turning now to the within-English conditions, we see significant priming in all four conditions. For the two Māori English target conditions (ME-ME and PE-ME), there was a significant difference in priming between the two conditions. Priming was significantly larger in the within-dialect ME-ME condition than in the cross-dialect PE-ME condition. In other words, the the prime language variety significantly affects the processing speed of Māori English targets. This was not the case for the Pākehā English target conditions (PE-PE and ME-PE), where there was no difference in the magnitude of priming. This means that the processing of Pākehā English targets is equally fast, regardless of whether the prime is in the standard Pākehā English variety or in the non-standard Māori English variety.

The GOAT vowel behaves in a special way in the English-only conditions as well. In the within-dialect ME-ME condition the GOAT vowel facilitates processing of both control and critical trials significantly more than the other three variables. In the cross-dialect PE-ME condition, however, it does not behave differently from the other phonetic variables. In the Pākehā English target conditions, all four variables prime at the same extent in the PE-PE condition. However, in the cross-dialect ME-PE condition, the GOAT vowel is the only one not facilitating priming.

The level of integration into Māori culture also had an effect in the within-English conditions. A high MII triggers fast response times on critical pairs in the ME-ME condition, while low MII evokes fast reaction times on control trials in the PE-PE condition.

## 2.6 Discussion

### 2.6.1 Bilingual Lexical Processing and Social Priming

The results of the short-term auditory lexical priming experiment consistently revealed a stronger, more intimate connection between Māori and Māori English, than between Māori and Pākehā English. As a possible explanation, I argue that both the Māori and the Māori English translation equivalents are associated with a *Māori* social category, while the Pākehā

English phonetic representations are associated with the *Pākehā* social category. The larger priming effects found between Māori and Māori English compared to Māori and Pākehā English suggest a direct activation link between the Māori language set of phonetic representations and the English language set of representations that are associated with the *Māori* ethnic category. This suggests that ethnicity activation operates under a *shared* system across the two languages of a bilingual speaker, and that phonetic representations associated with the same ethnic category can activate and interact with each other across the L1 and the L2. This confirms the main hypothesis, which was presented in Figure 2.1 and showed a schematic representation of this process. Being exposed to the Māori language phonetic representation [huka] (=SNOW) activates those English language representations that are also associated with the Māori ethnicity. 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 variables, the GOAT vowel exhibits the largest priming value. The Māori English GOAT vowel is the most innovative variant and is socially highly salient. Increased sensitivity to this variable generates stronger person construal associations, which makes ethnic categorization more salient. As the most innovative and almost categorically Māori English form, the fronted and monophthongized GOAT vowel receives the strongest Māori association, as it is 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 high *Māori* activation. Variants that have a strong, socially salient ethnic association are the ones that become activated the fastest across the L1 and L2. This explanation can account for the fact that we see the biggest processing facilitation between Māori English and Māori with words that contain the GOAT vowel.

Although social information seems to be shared across the two languages of a bilingual listener, the results also indicate that there are certain constraints on social category activation across the L1 and L2, depending on the direction of the activation. Significant priming effects were found in both of the L1-L2 conditions, that is, when the target word is in Māori and the prime word preceding it is either in Māori English or Pākehā English. However, the magnitude of priming was larger in the Māori English to Māori condition than in the Pākehā English to Māori condition. This indicates a greater activation of Māori targets in the ME-TR condition. I argue that the reason for this is that the Māori target word gets activated via two separate associations when it is primed with a Māori English translation equivalent. For one, the Māori target becomes activated through a lemma activation link, as the English and Māori translations share a conceptual representation. In addition, the Māori target also becomes activated via an independent social category activation link, because both the Māori target and the Māori English prime are associated with a *Māoriness* label. The Pākehā English prime also activates the Māori translation equivalent through the lemma activation link, as these two share a conceptual space as well. However, there is no social category activation between a Pākehā English prime and its Māori translation equivalent.

As an example, let us consider the English word *snow* and its Māori translation equivalent *huka*. When the bilingual listener hears the Pākehā English phonetic representation [snou], this activates the concept of SNOW, which then activates the lexemes *snow* and *huka*. This L1 to L2 conceptual activation link alone is strong enough to cause significant priming of the Māori lexical item *huka*. In addition to this conceptual activation, upon hearing the Pākehā English phonetic representation [snou], social category activation occurs as well. Pākehā English [snou] activates all things Pākehā in the bilingual's mind. However, this activation does not facilitate the processing of the Māori target, as Māori language representations are not associated with Pākehā labels.

When the bilingual hears the Māori English phonetic representation [snu], this also activates the concept of SNOW in both English and Māori. Thus, we see significant conceptual priming of *huka* through the lemma activation link from [snu]. At the same time, the Māori English pronunciation [snu] also activates all things Māori in the bilingual's mind, where the Māori lexical item *huka* is associated with a Māoriness label. As a result, *huka* also

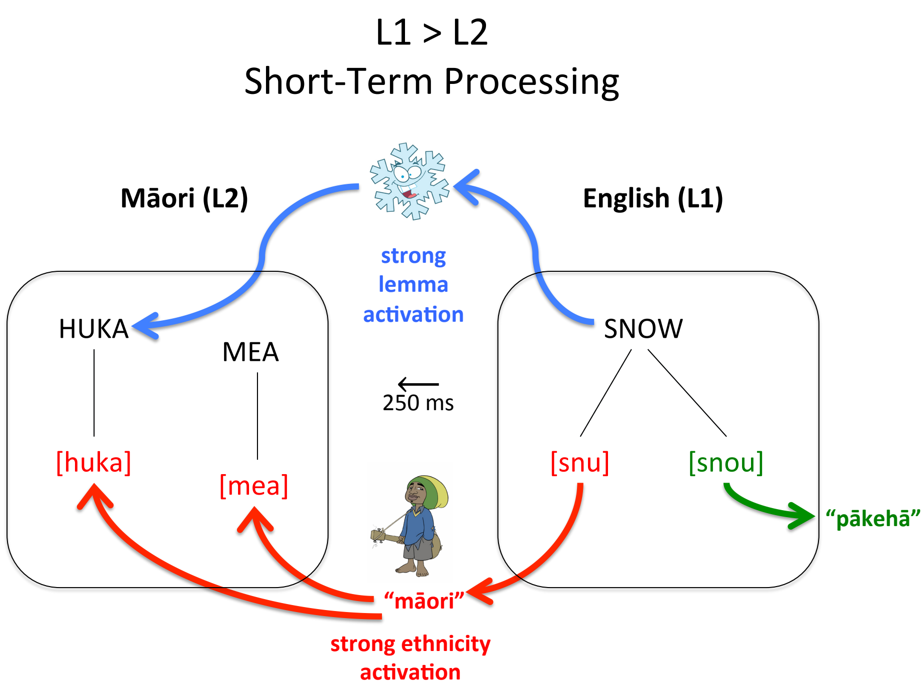


Figure 2.29: Strong lemma activation and strong social category activation from L1 to L2. Strong lemma activation and strong social activation independently cause faster lexical processing, and their effects are additive.

becomes activated through the social category activation link.

Regarding the difference in priming magnitude between the two conditions, I argue that the effects of the lemma activation and the social category activation are `additive`. In other words, the processing of *huka* is facilitated more by the Māori English [snu] than by the Pākehā English [snou] because it receives priming through both the lemma activation link as well as the social category activation link, whose effects add on to each other causing an increase in the magnitude of priming.

The story does not end here, as another issue remains regarding these processes in the L1-L2 direction. Recall that our results in the ME-TR condition showed that the socially salient Māori English GOAT vowel facilitated the processing of not only the critical trials but also the control trials. In other words, the Māori English phonetic representation [snu] does not only facilitate the processing of its translation equivalent *huka* in Māori, but also the processing of the unrelated Māori target word *mea* (=THING), for example. This suggests that the social category activation link between the L1 and the L2 is `independent` from the lemma activation link, and as such is capable of facilitating lexical processing by itself. Thus, I argue that in the L1-L2 direction, both the lemma activation link and the social category activation link are independently strong enough to facilitate lexical processing, and if both are present then their effects add on to each other. Figure 2.29 provides a schematic representation of these processes.

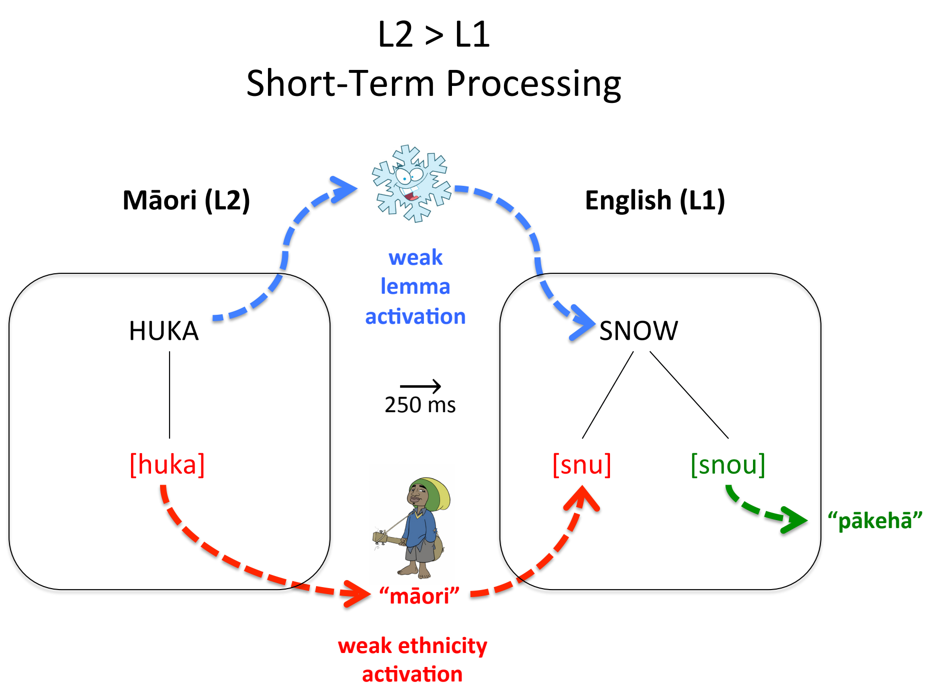


Figure 2.30: Weak lemma activation and weak social category activation from L2 to L1. Their effects are additive, and both are needed to achieve lexical priming.

In terms of the L2-L1 priming, our analysis showed significant results in the TR-ME condition but not in the TR-PE condition. That is, the Māori word *huka* significantly primes the Māori English translation equivalent [snu], but not the Pākehā English translation equivalent [snou]. As mentioned earlier, previous literature suggests that there is an asymmetry in translation priming between the L1-L2 and the L2-L1 directions. Bilingual priming studies consistently show significant forward priming effects, however, results are less consistent when the prime is in the L2 and the target is the L1. Significant L2-L1 priming has been found on occasion (Basnight-Brown and Altarriba, 2007; Duñabeitia, Perea, and Carreiras, 2010; Duyck and Warlop, 2009; Schoonbaert, Duyck, Brysbaert, and Hartsuiker, 2009), but other studies have only found near significance or no priming at all (Gollan, Forster, and Frost, 1997; Finkbeiner, Forster, Nicol, and Nakamura, 2004; Jiang and Forster, 2001). Note that these studies all investigate visual priming, rather than auditory priming. Using auditory stimuli, our experiment is able to highlight the importance of social category activation between the L2 and the L1. Assuming the same conceptual and social links posited for the L1-L2 data, I account for the L2-L1 priming results in the following way. The lemma activation link in the L2 to L1 direction is weaker than in the L1 to L2 direction. This weaker link is not strong enough to facilitate lexical processing by itself. That is, the reason we do not see significant priming from Māori to Pākehā English is that *huka* does not sufficiently activate SNOW at the conceptual level. We do, however, get significant priming from Māori to Māori English, which is demonstrated by *huka* priming [snu]. The Māori prime *huka* activates all things Māori, which includes the Māori English translation equivalent [snu]. Again, we see two links between Māori and Māori English - with additive effects - as opposed to the one link between Māori and Pākehā English. Crucially, all these links are weaker than they are in the L1-L2 direction, including the social category activation link itself. Recall that in the L1-L2 ME-TR condition the socially salient GOAT vowel facilitated the processing of both related and unrelated words in Māori. In the TR-ME condition, however, the facilitation of lexical processing was only present for the critical trials.

In other words, in this direction Māori *huka* facilitates the processing of the translation equivalent *snow*, but not the unrelated item *thing*. This suggests that in the L2-L1 direction both the social category activation link and the lemma activation link are weak, but they can enhance each other's effect. These two weak effects combined lead to significant priming from Māori to Māori English. The results in the TR-ME condition also demonstrated that this weaker social category activation link is only available to those bilinguals who are highly integrated into Māori society and cultural practices, and whose Māori English representations are presumably stronger. To sum up, in the L1-L2 direction I posit an independently strong lemma activation link and an independently strong social category activation link, while in the L2-L1 direction I propose a weak lemma activation link and a weak social category activation link. The additive effects of these weak links are still strong enough to cause significant priming, but neither can do so by itself. Figure 2.30 illustrates the weak lemma activation link and the weak social category activation link between Māori and the two English varieties in the L2-L1 direction.

## 2.7 Chapter Conclusion

Based on the results of a bilingual short-term auditory primed lexical decision task, this chapter demonstrated that social category activation operates under a shared, interactive system across the two languages of a bilingual speaker-listener. I argued that L1 representations can activate L2 representations, and vice versa, through a social category activation link. The results revealed that recent, innovative, and socially salient variants, such as the Māori English GOAT vowel, are most facilitative of social category activation across the L1 and L2. I posited a strong lemma activation link, and an independently strong social category activation link in the L1-L2 direction, while in the opposite L2-L1 direction these links are weaker, and both are needed to obtain significant lexical priming.

# Chapter 3

# Assessing Speech Community Membership

## 3.1 Chapter Overview

This brief chapter describes a Visual Analogue Scale (VAS) experiment, where participants were asked to evaluate lexical items based on how Māori- or Pākehā-sounding the word was. There were two main reason why this experiment was conducted. On the one hand, the short-term priming experiment revealed some priming asymmetries regarding the cross-language monolingual conditions. The rating experiment aims to investigate potential reasons behind this asymmetry with regard to the speakers' conformity to their own speech community. On the other hand, the visual analogue scale experiment also provides a means to assess whether the four different sociophonetic variables would be evaluated differently on a scale of Māoriness or Pākehāness. The experiment provides empirical evidence that the GOAT vowel is indeed socially salient, and the innovative variant is associated with Māoriness in current New Zealand society. Section 3.2 describes the priming asymmetry observed between the cross-dialect conditions. The methods of the VAS rating task are described in Section 3.3. The results are given in Section 3.5, and summarized in Section 3.6.

## 3.2 Introduction

The short-term priming experiment revealed some priming asymmetries regarding the English-language conditions. The present chapter examines this asymmetry in more detail. Figure 3.1 plots the reaction times to control and critical pairs in the ME-PE and PE-ME cross-dialect conditions. The ANOVA run on the four English only conditions revealed a significant effect of conditions, however, this particular pair of conditions were not analyzed together in the previous chapter, as the analysis there was broken down by target language variety. That is, the ME-ME condition was compared with the PE-ME condition, and similarly, the PE-PE condition was compared with the ME-PE condition. However, this asymmetry between the two cross-dialect conditions was noticeable in Figure 2.14.

Therefore, another ANOVA was run on these two conditions this time, with trial type (critical and control) and condition (ME-PE and PE-ME) as predictors, and reaction time as the dependent variable. The results revealed significant main effects of trial type ($F(1,1152)=117.75$, $p<.001$) and condition ($F(1,1152)=113.17$, $p<.001$). On top of the main effects there was also a significant interaction of trial type and condition ($F(1,1152)=7.81$, $p=.005$). A Tukey-test shows that reaction times to critical trials in the ME-PE condition (mean=756ms, sd=212ms) were significantly faster than to the critical trials in the PE-ME condition (mean=916ms, sd=216ms) (Tukey's HSD, $p<.001$). Furthermore, reaction times to the control trials were significantly faster in the ME-PE condition (mean=922ms, sd=183ms) than in the PE-ME condition (mean=1013ms, sd=209ms). This means that the mean facilitation of lexical processing in the ME-PE condition was 166ms, while in the PE-ME condition it was only 97ms.

Recall that primes were always pronounced by the female speaker, while the targets were always pronounced by the male speaker of each variety. Essentially this means that cross-dialect priming was greater when a Māori English female prime was followed by the Pākehā English male target, than when the Pākehā English female prime was followed by the Māori English male target. Based on this it was hypothesized that there might be a greater perceptual difference between the Pākehā English female speaker and the Māori English male speaker, than between the Māori English female speaker and the Pākehā English male speaker. In other words, I hypothesized that the Māori English female speaker might be less Māori-sounding than the Māori English male speaker. In order to quantitatively measure the per-

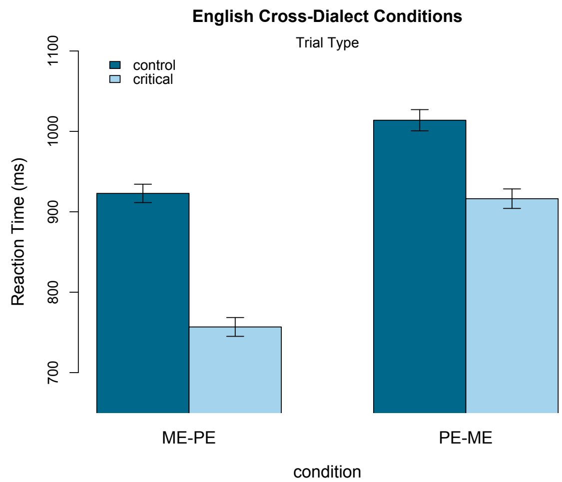


Figure 3.1: Cross-dialect asymmetry: ME-PE and PE-ME conditions.

ceptual difference between the speakers, an experiment was run where participants were instructed to rate on a scale of Pākehā sounding to Māori sounding all the lexical items that formed part of the critical and control pairs in the previous experiment. A second aim of this follow-up study was to investigate potential rating differences in terms of the four sociophonetic variables used in the priming experiment. In particular, the study aimed to determine whether the GOAT vowel would elicit responses different than the other three variables.

## 3.3 Methods

Fifteen Māori participants took part in this experiment. None of them had participated in the short-term priming experiment. The stimulus material included all the critical items used in the short-term priming experiment. This means 81 items produced by each of the six speakers, totalling 486 words. In other words, this task used words from the two varieties of English, as well as Māori words. A list of the 81 critical translation pairs can be found in Table 1 in Appendix One.

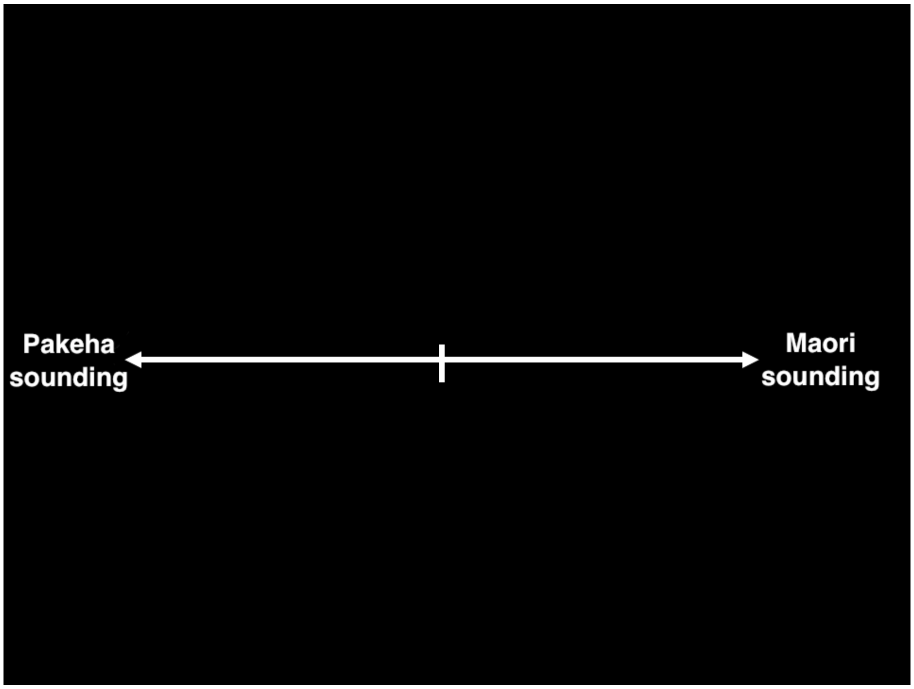


Figure 3.2: Visual Analogue Scale presented on the screen.

A Visual Analogue Scale (VAS) was used for this experiment. A screenshot of the scale is provided in Figure 3.2. In a VAS rating task, individuals are instructed to scale some type of a perceptual parameter by indicating their percept on an idealized visual display. The VAS has been widely used in medical studies to assess patients' pain levels (e.g., Ohnhaus and Adler, 1975). More recently, the VAS task has also been successfully used in fricative perception studies by Urberg-Carlson et al. (2008) and Munson (2011), who argue that VAS ratings are more useful than binary categorization responses because they allow the gradient perception of fricatives to be tracked. in the present study the VAS task allows the listeners to make continuous rather than discrete perceptual judgments about the ethnicity of a speaker. An arrow was displayed on the computer monitor immediately after each stimulus was played. One end of the arrow was labelled as *Pākehā-sounding* and the other end of the arrow was labelled as *Māori-sounding.*

Participants were instructed to click anywhere on the arrow, based on their judgment of how Pākehā- or Māori-sounding each word was.

The stimuli were presented in a random order for each listener, and participants had 2.5 seconds to make a decision on each word. Half of the listeners saw a visual analogue scale with Māori-sounding written on the right side of the screen, while half of them saw Māori-sounding written on the left side of the screen. Words were presented through headphones and the experiment was run using the E-Prime psycholinguistics software (Schneider et al., 2007) on a portable laptop. Before the experiment started participants were required to complete a test phase where they were instructed to click on circles presented at various points along the arrow. All participants were individually tested in a quiet room. The experiment lasted around 25 minutes with an optional break in the middle.

## 3.4 Analysis

Each response returns a click location value which corresponds to a pixel number on the screen. The middle of the arrow corresponded to pixel number 310. This mid-point was treated as zero, and all responses were transformed accordingly. Results from participants who originally saw the screen with Pākehā-sounding on the left were flipped around the mid-point of the scale. This means that high positive numbers indicate a Māori-sounding word, while low negative numbers indicate a Pākehā-sounding word.

## 3.5 Results

Figure 3.3 demonstrates the distribution of ratings for all six speakers. The top panels show the ratings for the Māori English speakers, the middle panels plot the ratings for the Pākehā English speakers, while the Māori speakers' ratings are shown in the bottom. Not surprisingly, the Pākehā speakers are judged to be more Pākehā-sounding, while the Māori English speakers and the Māori language speakers are judged to be more Māori-sounding.

These ratings are not normally-distributed (as confirmed by a Shapiro-Wilk normality test), therefore to investigate differences in the distribution between the female and the male speakers within a variety, Wilcoxon signed rank tests were used. This analysis revealed a significant difference between the ratings of the Māori English female speaker (mean=92, sd=111) and the Māori English male speaker (mean=156, sd=74) (V=570316, p<.001). This suggests that the female speaker is indeed less Māori-sounding than the male speaker. The kurtosis of the two distributions also shows a large difference. The female ME speaker's kurtosis is 1.37, while the male speaker's is 5.32. In other words, the female speaker's ratings show a less "peaky" (i.e., more flat) distribution than the male speaker's ratings. There was also a significant difference between the ratings of the Pākehā English female speaker (mean=-138, sd=102) and the Pākehā English male speaker (mean=-155, sd=86) (V=327235, p=.025). This suggests that the Pākehā English male speaker is more Pākehā-sounding than the female speaker. There was no significant difference between the ratings of the female Māori language speaker (mean=165, sd=87) and the male Māori speaker (mean=150, sd=108).

Next the ratings for each sociophonetic variable were investigated. Figure 3.4 shows the distribution of ratings for the four phonetic variables produced by the Māori English male speaker. What is interesting to note here is that the GOAT vowel exhibits a categorical distribution, in that all the ratings are on the Māori side of the continuum. In other words, lexical items containing a GOAT vowel were judged to be categorically Māori-sounding. This is not the case with regards to the other three variables. Figure 3.5 plots the same variables by the Māori English female speaker. Even though the female speaker is overall less Māori-sounding than the male speaker, her GOAT vowels are also judged to be categorically Māori-sounding. The other three variables exhibit a much wider distribution. The Pākehā English male speaker's ratings are plotted in Figure 3.6. Again the GOAT vowel behaves differently from the other variables, exhibiting a categorically Pākehā distribution. Figure 3.7 shows the Pākehā English female speaker's ratings in terms of the four sociophonetic variables. This plot suggests that the Pākehā English female speaker might be the exception, as her GOAT vowels are not categorically distributed, unlike the other three English speakers. However, closer analysis of the data revealed that this was caused by one particular participant's ratings. Participant #7 identified the PE female speaker as overall Māori sounding. Once this participant is excluded from the analysis, the GOAT vowel shows the same categorical distribution as seen in the other three speakers' ratings. Figure 3.8 demonstrates the distributions without Participant #7's responses.

## 3.6 Summary

This experiment was carried out to investigate what might account for the finding that Māori English effectively primes Pākehā English, while the reverse pattern is less true. The results of this experiment seem to suggest that the priming asymmetry observed between the ME-PE and PE-ME cross-dialect conditions might indeed be caused by the Māori English female speaker sounding less Māori than the male Māori English speaker. In other words, the ME female speaker is more Pākehā-sounding, and I suggest that it is for this reason that her voice more effectively primes the Pākehā English voice. However, the results regarding the difference in overall ratings between the ME female speaker and ME male speaker are perhaps not surprising. King (1999) noted that Māori English is predominantly associated with male speakers. This statement might still hold these days, however, to my knowledge no research has followed up on this issue since King (1999).

The second reason for conducting this visual analogue scale experiment was to assess whether the four different sociophonetic variables would be evaluated differently. In the short-term experiment the results revealed that it is the Māori English GOAT vowel that facilitates lexical processing the most across Māori English and Māori. It was argued in Section 2.6 that – as the most recent, most innovative sociophonetic variable – the GOAT vowel generates stronger person construal associations, which makes ethnic categorization more salient. Indeed, the results of this experiment confirmed this assumption. Māori English lexical items containing the GOAT vowel are strikingly consistently and categorically judged as Māori-sounding. Similarly, Pākehā English words containing the GOAT vowel are also categorically judged to be Pākehā-sounding.

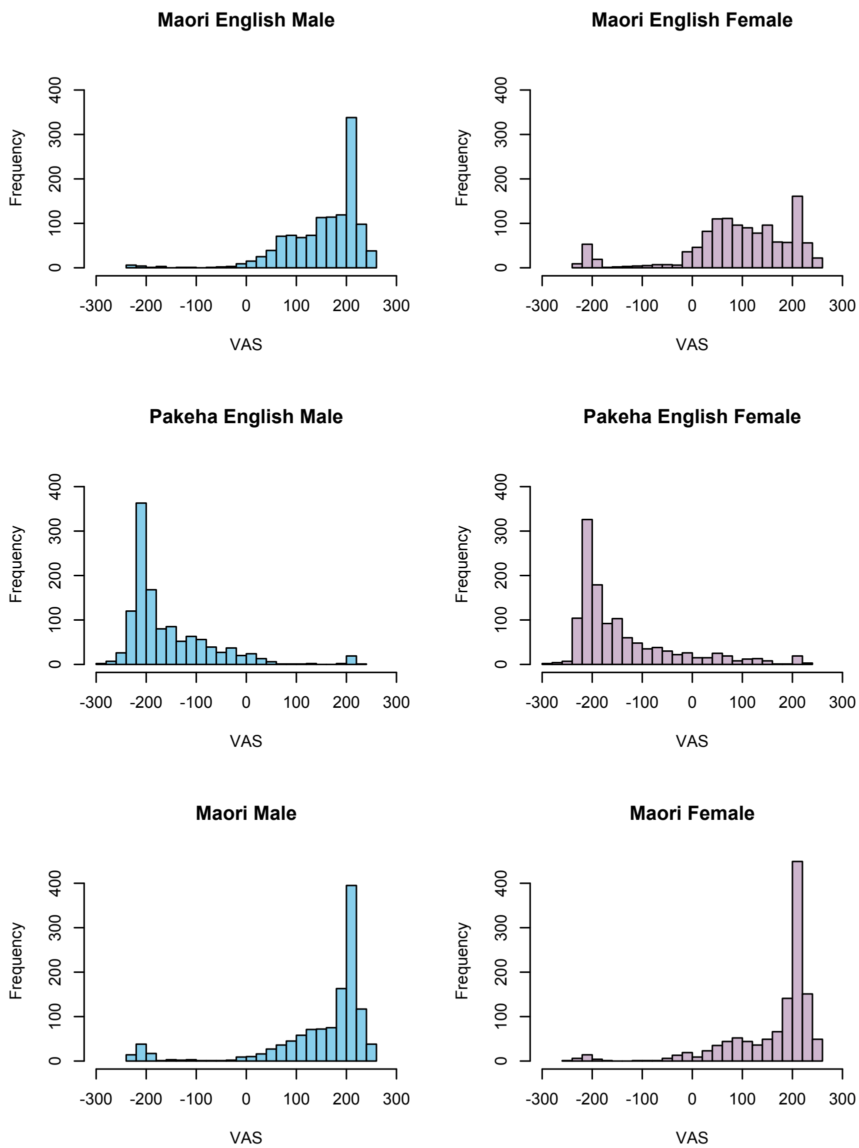


Figure 3.3: Histograms of visual analogue scale (VAS) Māoriness ratings for all critical items by the six speakers. High positive VAS numbers mean *Māori sounding*, low negative VAS numbers mean *Pākehā sounding*.

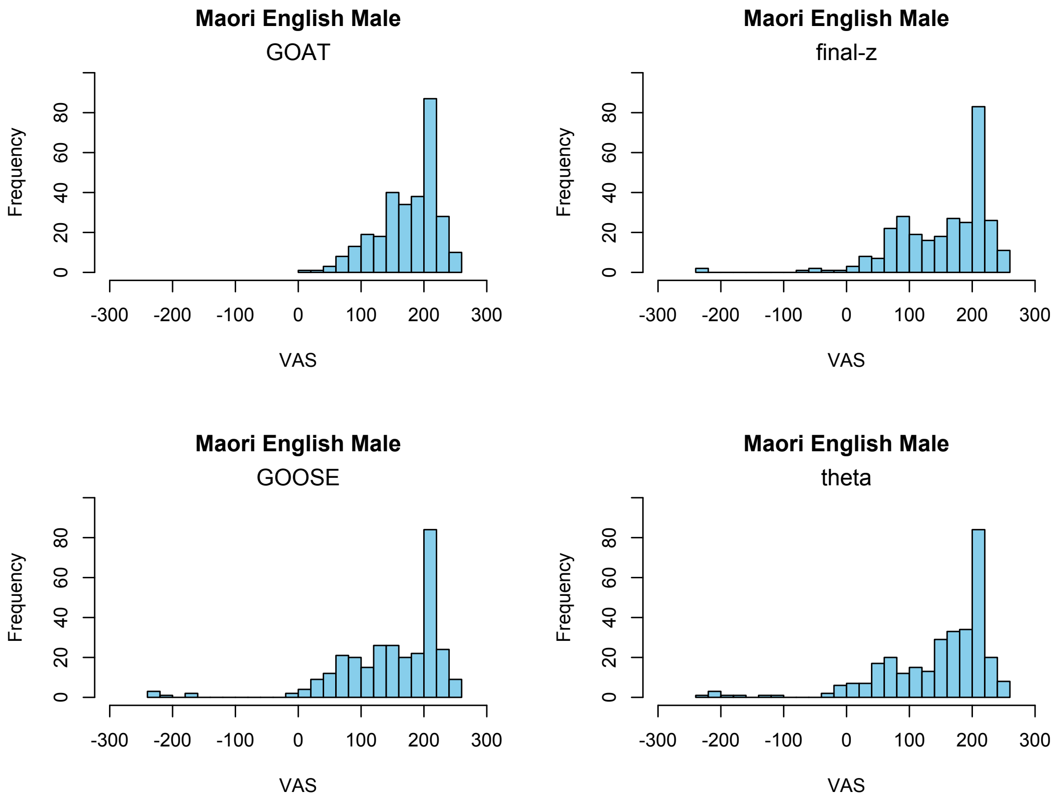


Figure 3.4: Histogram of visual analogue scale Māoriness ratings for the four sociophonetic variables of the Māori English male speaker.

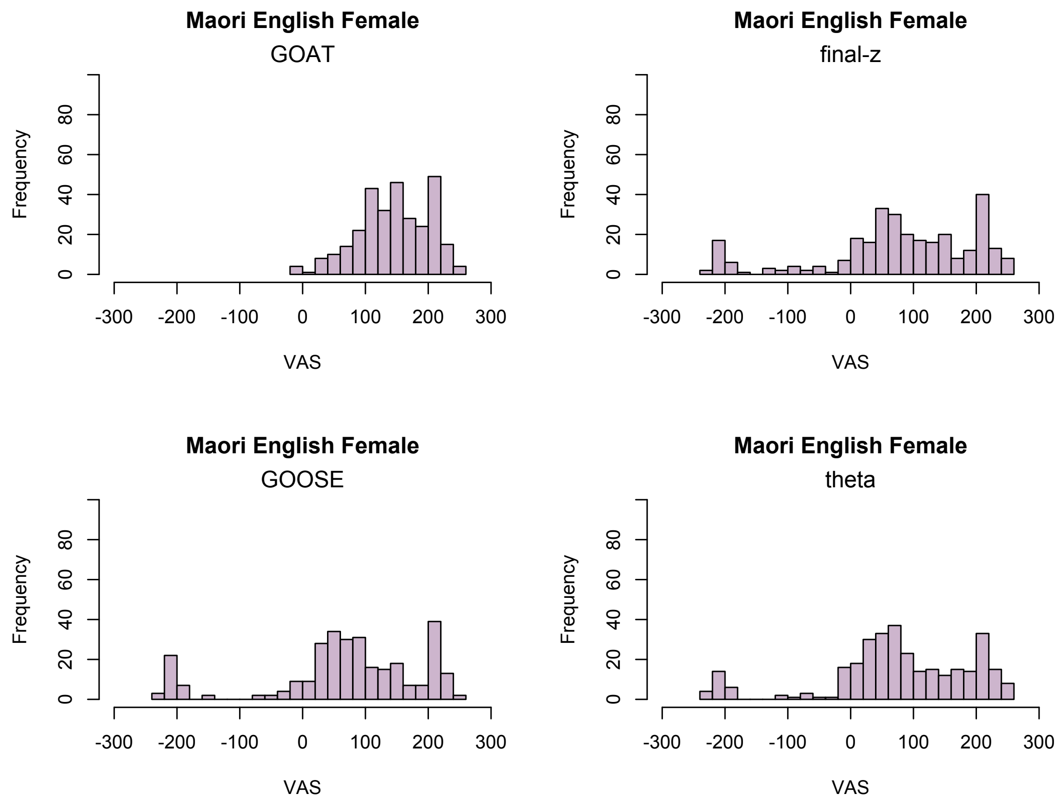


Figure 3.5: Histogram of visual analogue scale Māoriness ratings for the four sociophonetic variables of the Māori English female speaker.

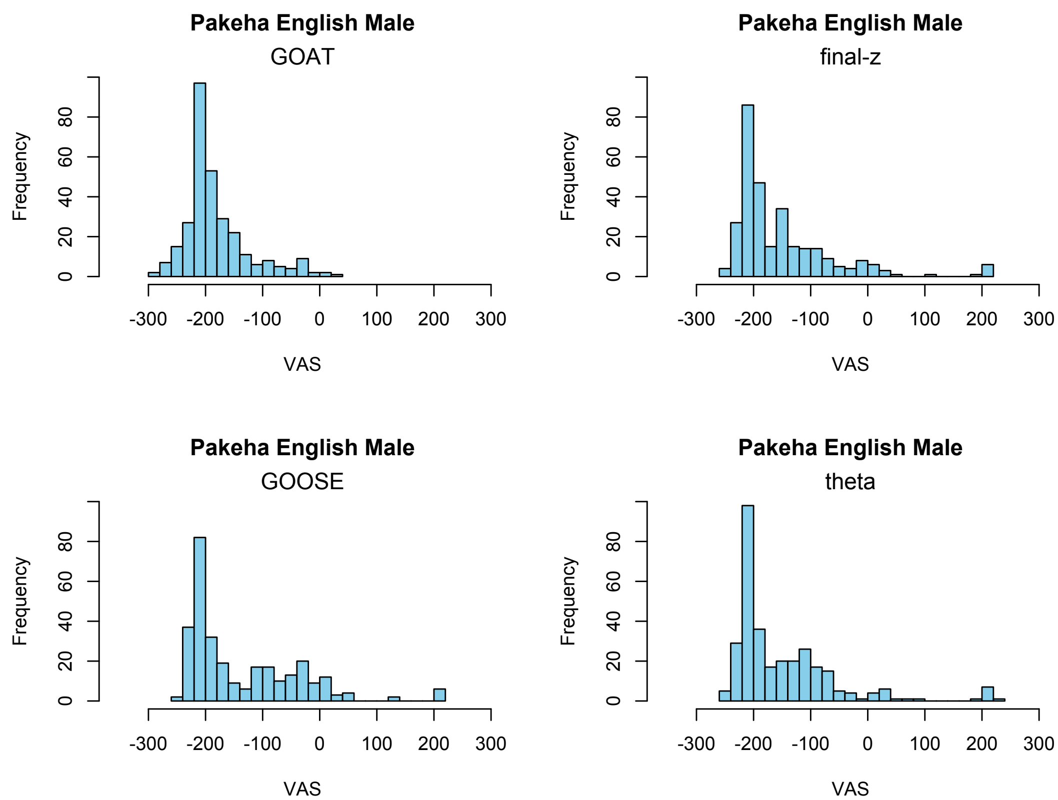


Figure 3.6: Histogram of visual analogue scale Māoriness ratings for the four sociophonetic variables of the Pākehā English male speaker.

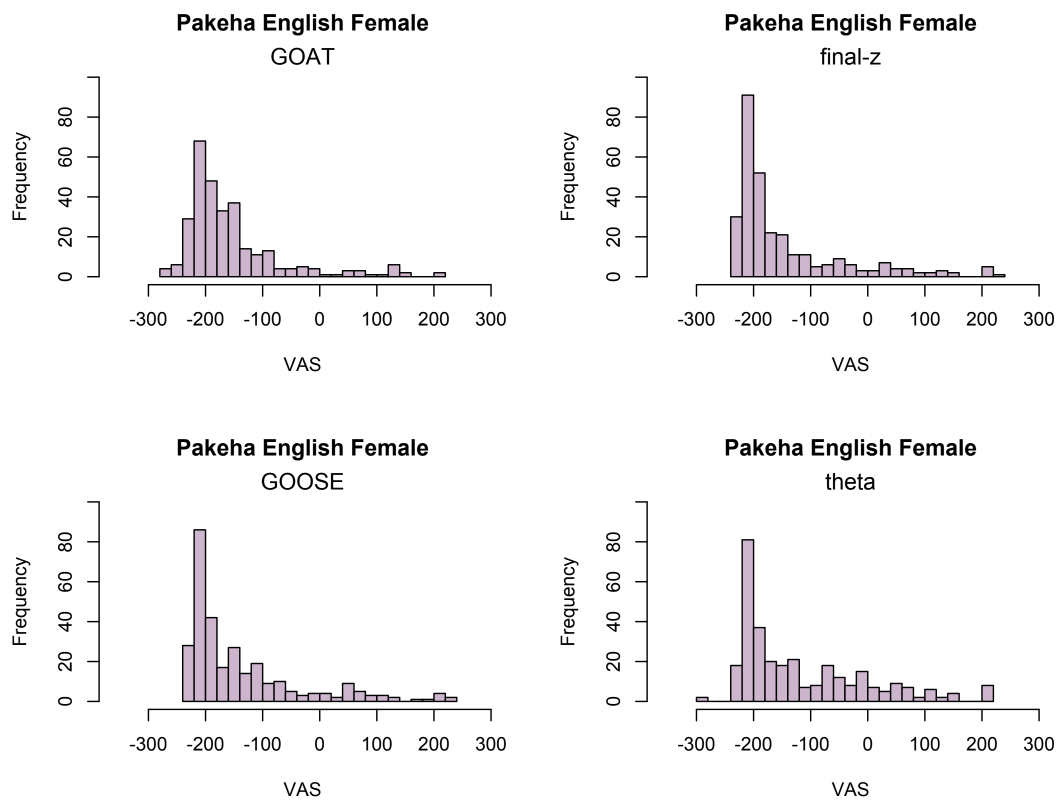


Figure 3.7: Histogram of visual analogue scale Māoriness ratings for the four sociophonetic variables of the Pākehā English female speaker.

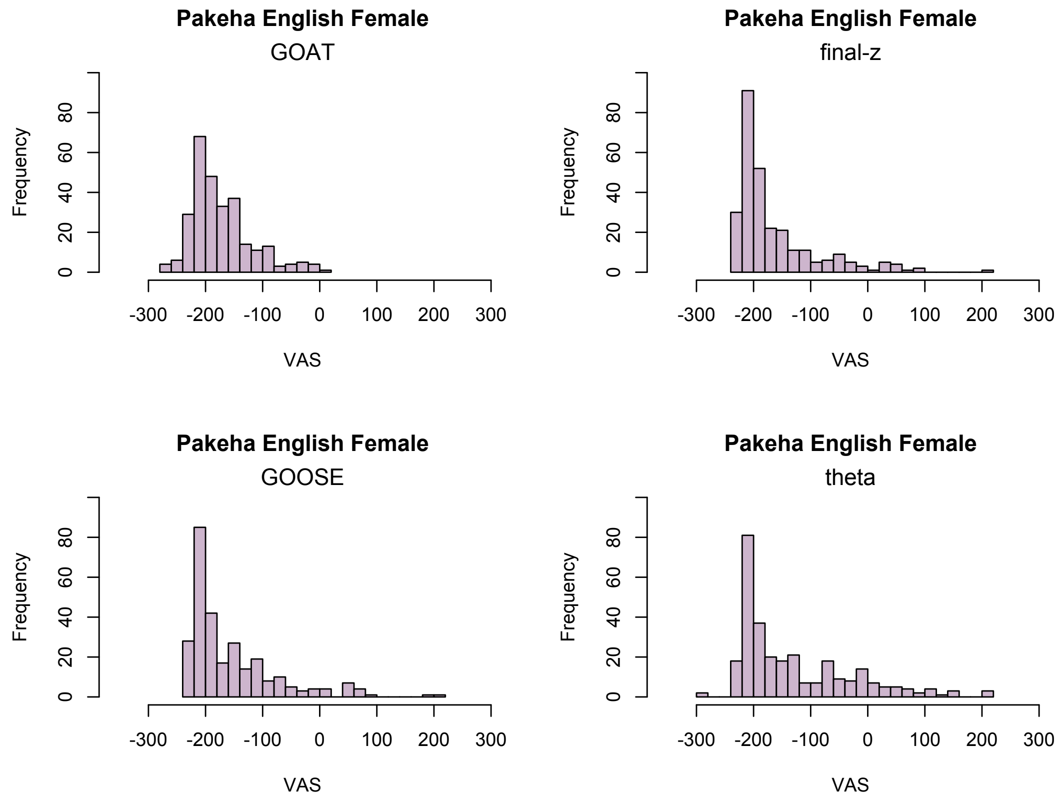


Figure 3.8: Histogram of visual analogue scale Māoriness ratings for the four sociophonetic variables of the Pākehā English female speaker, excluding data from Participant #7.

# Chapter 4

# Effect of Dialect on Bilingual Lexical Representation

## 4.1 Chapter Overview

Chapter 4 investigated the effect of ethnic dialect on bilingual language processing. Using a short-term cross-language/cross-dialect priming paradigm it was shown that the activation of ethnicity operates simultaneously across the L1 and L2. I demonstrated that innovative, socially salient phonetic variants facilitate translation priming during language processing, and that, in fact, ethnicity activation can facilitate lexical processing independently from lemma activation in the L1 to L2 direction during speech processing. In the course of speech perception a distinction must be made between the immediate *processing* of lexical items and their *representation* in long-term memory. As the short-term priming paradigm can only give us insight into the immediate processing of words, a *long-term priming* paradigm must be used to investigate the effect of social information on encoded lexical representations (e.g., Sumner and Samuel, 2009). After a brief introduction, the methods of the long-term priming experiment are described in Section 4.3. Accuracy results are described in Section 4.4, and Reaction Time results are given in Section 4.5). The results demonstrate that shared representations across L1 and L2 are part of *social context*, and not part of superficial segmental similarity, which is discussed in Section 4.6.1. A model of bilingual lexical representation and social priming is given in Section 4.6.2. Concluding remarks can be found in 4.7.

## 4.2 Introduction

Previous research has failed to find strong evidence for long-term translation priming using a lexical decision task (e.g., Gerard and Scarborough, 1989; Kirsner et al., 1980), and reliable priming effects have only been found with a conceptual implicit memory task. For example, Zeelenberg and Pecher (2003) suggest that "long-term cross-language repetition priming is obtained in tasks that require access to conceptual knowledge but not in tasks in which access to conceptual knowledge is not required", such as a lexical-decision task. Using Dutch-English bilinguals, Zeelenberg and Pecher (2003) show that cross-language long-term repetition priming effects can be obtained through an animacy-decision task. The study by Mo et al. (2005) used highly proficient Chinese-English bilinguals and also demonstrated long-term repetition priming effects, showing that fluent speakers were able to access L2 conceptual representations directly from the L2 lexicon. Following up on the study by Mo et al. (2005), the lexical representation and processing of low proficiency Chinese-English bilinguals were examined by Li et al. (2009). In this study long-term repetition priming effects were obtained in conceptual tasks but not in lexical decision tasks. The authors concluded that low-proficiency bilinguals can only access the conceptual representations of L2 words via the L1 lexicon. Note that these studies use a visual priming paradigm, where the stimulus material is presented orthographically on a computer screen. This practice completely eliminates the possibility of investigating the potential effect of phonetic variation in the study of bilingual lexical representations.

The present chapter demonstrates that long-term cross-language priming effects can be obtained using a lexical decision task if the two language varieties are associated with the same social category. In order to investigate the effect of social information on bilingual language representation, a novel cross-language/cross-dialect auditory long-term priming paradigm was used in the New Zealand context, where Māori and English are both official languages. New Zealand English itself comprises two main ethnic dialects: Māori English and Pākehā English. Māori English is predominantly spoken by the indigenous Māori population, while Pākehā English is mainly spoken by people of European descent.

The long-term priming paradigm used in this chapter is an extension of the monolingual cross-dialect paradigm used by Sumner and Samuel (2009). As mentioned previously, Sumner and Samuel (2009) investigated what role episodic and abstract 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 separate, individual representations. They also tested whether this is dependent on language experience. In a series of three 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]. The experiments were described in detail in Section 1.3.3. Here I revisit their third experiment, which used the long-term priming paradigm to shed light on long-term mental *representation*, rather than immediate processing, and investigate how these variants are stored in the participant's mind. In such a paradigm primes and targets are presented in two separate blocks, and the time between a prime and its target is 20-30 minutes. The design was otherwise similar to the first experiment. The results revealed a different pattern from the previous short-term priming experiment. This time the Covert NYC group (who are rhotic speakers) patterned with the General American group in that they showed no long-term priming effect when the prime was an r-less NYC variant. This is different from the Overt NYC group who encode both variants of final -r equally well, and either form can facilitate the recognition of either form even after a long lag. The GA and Covert NYC participants on the other hand only encode the r-ful form. This implies that the Covert NYC group encode the r-less form as a variant of the underlying r-ful form during word recognition. Sumner and Samuel (2009) see this process "as the ability to map a wider set of inputs onto the single underlying representation". The results of this study demonstrate the malleable and variant nature of perceptual representations, dependent on the speaker/listener's language background.

I make use of this paradigm to investigate how ethnic category is shared across the L1 and L2 at the long-term representational level, by examining the effect of ethnic dialect on bilingual language representation.

## 4.3 Methods

### 4.3.1 Stimuli

The long-term priming experiment used the same critical stimulus material as the short-term priming experiment, and the same nine experimental conditions. The same eighty-one English-Māori translation pairs were used as critical pairs, (for a complete list see Table 1 in Appendix One), and again they were randomly re-paired to create non-related control pairs. For a detailed description of the stimulus material, refer back to Section 2.3.1. The only difference between the short-term and the long-term experiments has to do with the experimental design and procedure.

### 4.3.2 Design

In the short-term experiment primes and targets were presented in pairs with an inter-stimulus interval of only 250ms. The long-term priming paradigm, however, presents primes and targets in two separate blocks, and lexical decision is to be made on each item, rather than just the target words. Both the prime block and the target block contained 360 lexical items each. All words in the prime block were produced by the female speakers, and all words in the target block were produced by the male speakers. The same nine counterbalanced lists were created as for the short-term experiment previously (see Figure 2.2). Again, no list contained both critical trials and control trials for the same condition. Both the prime block and the target block included 45 critical items (from five conditions) and 36 control items (from four conditions). On top of the critical and control items, both blocks contained 99 filler words and 180 pseudo words. This means that unlike in the short-term experiment, the pseudo words serve as primes as well. To keep a 50% English - 50% Māori language ratio in each block, 90 pseudo words came from Māori, while 45 came from Māori English, and another 45 from Pākehā English. The relatedness proportion in this paradigm was at a satisfyingly low 0.25.

Note that in this long-term paradigm the notion of experimental condition is only meaningful for the critical pairs. A critical pair is made up of a target word in the target block, and a related prime word that was previously heard in the prime block. In the TR-ME condition, for example, this would mean hearing the Māori word *huka* (=SNOW) in the prime block, and then later hearing its Māori English translation equivalent [snu] in the target block. However, a control item in the the target block just means that its related prime has not been previously heard in the prime block. There is no meaningful way for participants to pair it up with a particular unrelated Māori word, such as *mea* (=THING) for example, in the prime block. This is in stark contrast to the short-term paradigm, where both critical primes and targets, and control primes and targets were paired up in an obvious manner.

### 4.3.3 Procedure

This experiment was run using the E-Prime psycholinguistics software (Schneider et al., 2007) on the same portable laptop as the short-term experiment. All participants were individually tested in a quiet room, and the stimulus material was presented over headphones. Participants first heard the prime block with 360 items spoken by the female speakers: one Pākehā English speaker, one Māori English speaker, and one Māori language speaker. Next they heard the 360 items in the target block with the male speakers, again one Pākehā English speaker, one Māori English speaker, and one Māori language speaker.

Participants were required to make lexical decisions on each item. They were instructed to press the right arrow key for a real word response, and

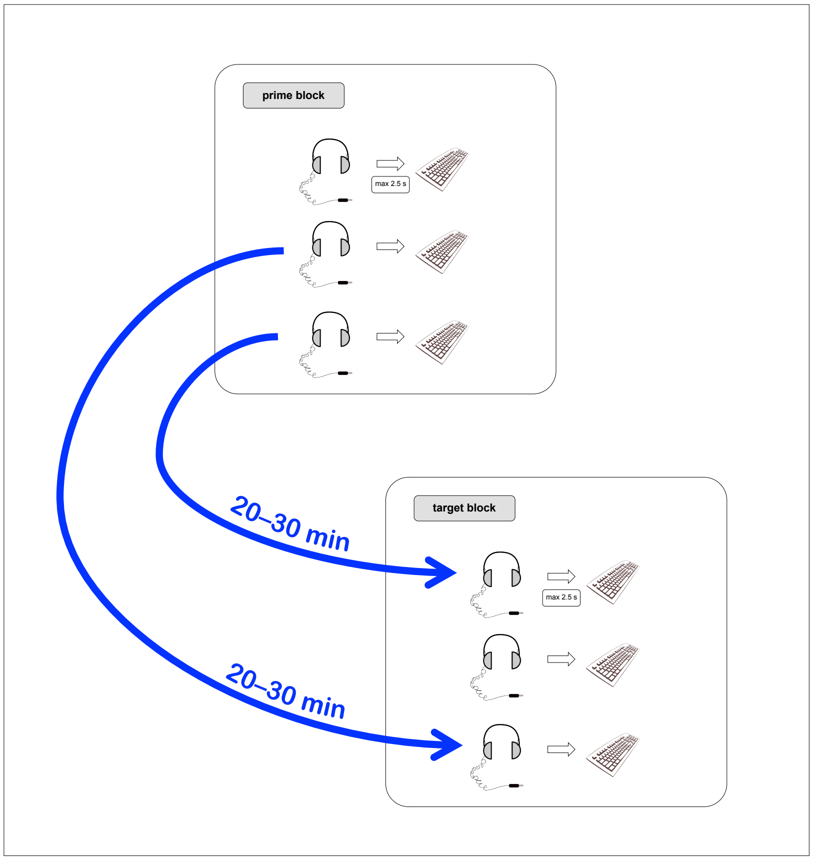


Figure 4.1: Experimental procedure for the long-term auditory primed lexical decision task.

the left arrow key for a non-word response. They had 2.5 seconds available to make a lexical decision on each word. The experiment started with eight practice trials, after which subjects were allowed to ask questions and clarifications. Subjects were again 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 instructed to respond as fast as possible without compromising accuracy. As feedback, their reaction time was displayed on the screen after each trial for 1.5

seconds, 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 55 minutes, with an optional break between the prime block and the target block, after the first 360 lexical items. Stimuli were presented in a different pseudo-random order for each participant. Figure 4.1 provides a visual representation of the experimental setup in the long-term priming experiment. At the end of the experiment participants were required to fill out an anonymous background information sheet.

### 4.3.4 Participants

Forty-five English (L1) – Māori (L2) bilinguals participated in the long-term auditory lexical decision task. No participant reported any hearing impairment. Twenty-seven females and 18 males took part, with an age range of 18-41 (mean=26.02). Subjects were recruited by the snowball method in the cities of Christchurch and Auckland, and all received monetary compensation for their participation. Forty-three participants identified themselves as ethnically Māori, and two as ethnically European.

A Māori Integration Index was calculated for each participant. As mentioned earlier, the MII is constructed form responses to eight questions presented on the background information sheet (see Appendix 5.3), and measures participants level of involvement in the Māori community, and thus, their exposure to Māori English. The MII has been previously used successfully in production and perception experiments on suprasegmentals, and showed significant effects in the short-term priming experiment in Chapter 2 of this dissertation. The distribution of Māori Integration Index scores for the 45 participants in the long-term priming experiment is presented in Figure 4.2. MII scores ranged from 5.5 to 16 (where the possible range is 0 to 17), with a median score of 12. Subjects with a score lower than the median were assigned to the Low MII Group, while subjects with a score equal to or higher than 12 were assigned to the High MII Group for the purpose of analyses using group data. Figure 4.3 shows the distribution of Māori Integration Index scores according to L2 proficiency. MII scores in the low proficiency group are significantly lower than in the advanced group (t(35.64)=-2.47, p=.018). Participants were divided into advanced and low L2 proficiency groups, based on the same criteria as for the short-term experiment (see Section 2.3.4). Table 4.1 shows the number of participants in each condition by trial type and Māori Integration Index in the target block. Table 4.2 shows the number of participants in each condition by trial type and L2 proficiency level in the target block.

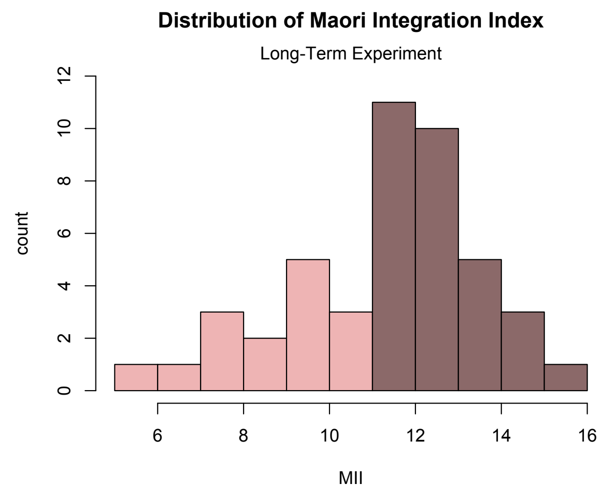


Figure 4.2: Distribution of participants' Māori Integration Index in the long-term experiment.

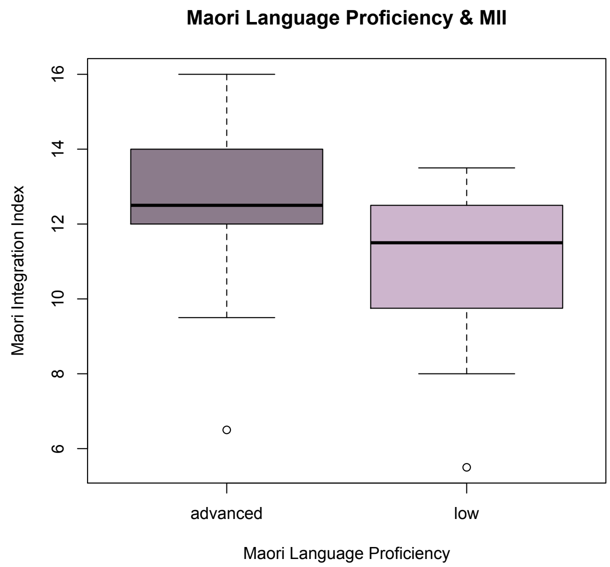


Figure 4.3: Participants' Māori Integration Index and Māori language proficiency level in the long-term experiment.

Table 4.1: The number of participants in each condition by trial type and Māori Integration Index in the long-term experiment.

| | control trials | | critical trials | |
|---|---|---|---|---|
| condition | high-MII | low-MII | high-MII | low-MII |
| ME-ME | 9 | 11 | 9 | 16 |
| ME-PE | 6 | 14 | 12 | 13 |
| ME-TR | 10 | 10 | 8 | 17 |
| PE-ME | 8 | 12 | 10 | 15 |
| PE-PE | 10 | 10 | 8 | 17 |
| PE-TR | 8 | 12 | 10 | 15 |
| TR-ME | 8 | 12 | 10 | 15 |
| TR-PE | 5 | 15 | 13 | 12 |
| TR-TR | 8 | 12 | 10 | 15 |

Table 4.2: The number of participants in each condition by trial type and L2 proficiency levels in the long-term experiment.

| | control trials | | critical trials | |
|---|---|---|---|---|
| condition | advanced | low prof. | advanced | low prof. |
| ME-ME | 5 | 15 | 13 | 12 |
| ME-PE | 10 | 10 | 8 | 17 |
| ME-TR | 9 | 11 | 9 | 16 |
| PE-ME | 7 | 13 | 11 | 14 |
| PE-PE | 7 | 13 | 11 | 14 |
| PE-TR | 10 | 10 | 8 | 17 |
| TR-ME | 9 | 11 | 9 | 16 |
| TR-PE | 8 | 12 | 10 | 15 |
| TR-TR | 7 | 13 | 11 | 14 |

## 4.4 Accuracy Results

As mentioned above, in the long-term experiment `condition` is only meaningful for the critical pairs. For filler and pseudo words there is no meaningful way for participants to match up a target with an unrelated word in the prime block. This has two consequences for the analysis of accuracy results.

First, we cannot examine participants' accuracy on filler and pseudo target words by experimental condition, like we were able to in the short-term experiment (the relevant plot was presented in Figure 2.6). However, we can still look at accuracy differences between primed critical items and unprimed control items within each condition. This will be presented in Section 4.4.1.

Second, sensitivity and response bias scores cannot be calculated for each separate condition, as these measures take both HIT rates and FALSE ALARM rates. False alarm rates are calculated based on responses to pseudo words, however, we cannot meaningfully assign a pseudo word to a particular condition in this paradigm. For example, upon hearing the Māori English pseudo target word [smið], it is not obvious whether it is linked to a Māori English prime, a Pākehā English prime, or a Māori language prime in the first block.

That is, it is not clear whether it belongs to the ME-ME condition, the PE-ME condition, or the TR-ME condition. For this reason, d' and response bias scores are calculated based on target language variety (=ME, in our example), and not based on experimental condition. This analysis will be presented in Section 4.4.2.

### 4.4.1 Percent Correct

#### Overall Results

Overall, participants performed at a 82.07% accuracy rate in the target block of the long-term auditory lexical decision task. In the prime block the overall accuracy rate was 80.78%, that is, we see a slight increase in accuracy rates in the target block, which contains items that have been primed.

Figure 4.4 shows percent correct accuracy levels to primed critical items and unprimed control items in the target block. It can be seen that in only two of the nine conditions do people perform more accurately on items that have been primed than on items that have not been primed: these are the two within-dialect English-only conditions (ME-ME and PE-PE). In the bilingual PE-TR condition participants performed worse on Māori target items whose Pākehā English translation had been presented in the prime block, than on Māori targets whose translation equivalent had not been presented at all. That is, hearing the PE translation first, actively interfered with response accuracy on Māori targets twenty minutes later.

### 4.4.2 Sensitivity and Response Bias

Sensitivity and response bias scores were calculated for each target language variety in the target block. Responses to Māori English target words were overall slightly more accurate than to Pākehā English or Māori language targets, but an ANOVA revealed no significant effect of language variety. These d' values are plotted in Figure 4.5.

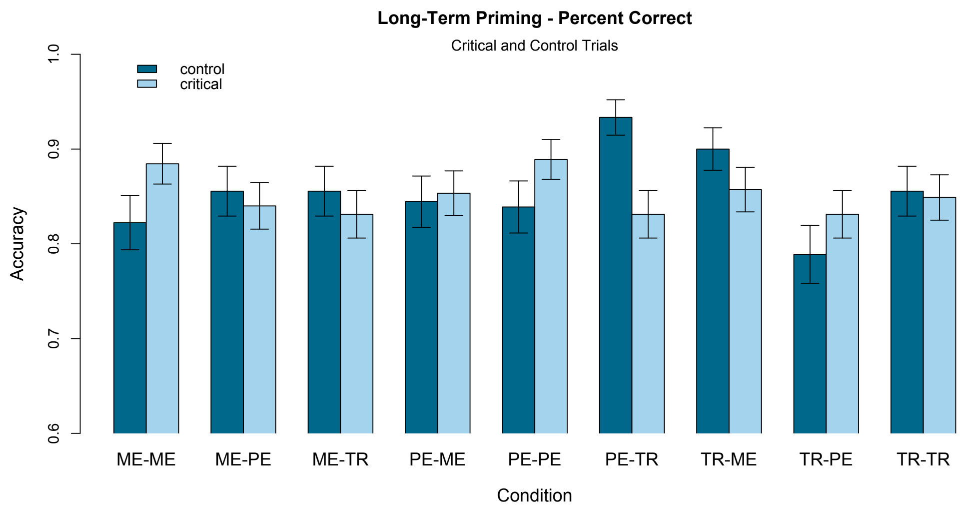


Figure 4.4: Overall percent correct for each condition in the target block.

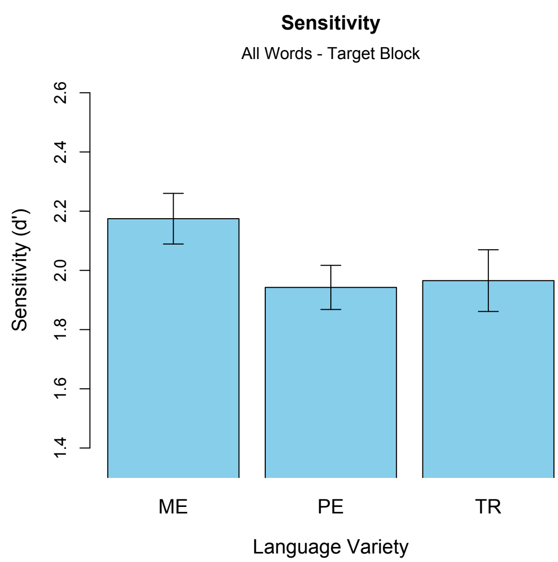


Figure 4.5: Sensitivity by language variety in the target block. A high d' score means that participants readily distinguish real words from non-words.

An ANOVA was also run on the response bias data, and found a main effect of target language variety (F(2,132)=5.6, p<.01). A post-hoc multiple comparison revealed that participants have a significantly more negative response bias on Māori language targets than on Māori English targets (Tukey's HSD, p<.01). This means that participants are more likely to misidentify a Māori non-word as a real word, than a Māori English non-word as a real-word. The Pākehā English bias scores were not significantly different from either Māori or Māori English scores. Figure 4.6 illustrates the response bias values for the three language varieties.

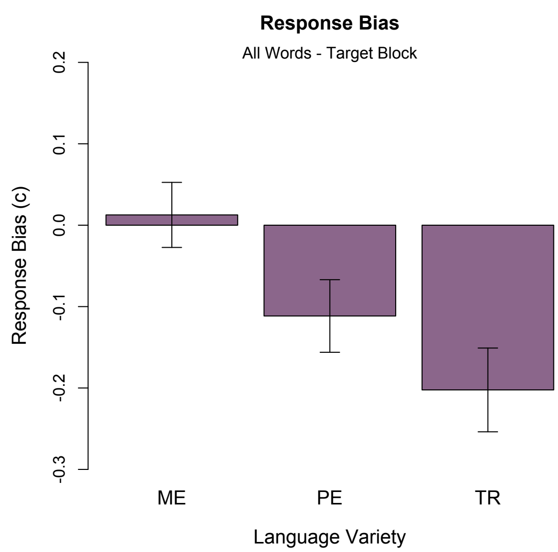


Figure 4.6: Response bias by language variety in the target block. A positive bias indicates a tendency to respond *non-word*. A negative bias indicates a tendency to respond *real word*.

No effects of MII or L2 proficiency were found on sensitivity and bias scores. This is likely caused by the combined analysis of the various conditions. Recall that in the short-term experiment, Māori English targets exhibited a significantly positive non-word bias in two of the three conditions (TR-ME and PE-ME), while in the within-dialect ME-ME condition there was no tendency for participants to misidentify a Māori English real word as a pseudo-word. It is possible that we would see similar differences in the long-term priming experiment, were we able to carry out an analysis for each condition separately.

## 4.5 Reaction Time Results

### 4.5.1 Analysis

Reaction time analysis was carried out in the same way as for the short-term experiment. Only trials with an accurate lexical decision response were used, and only critical and control trials were taken into consideration. Outliers over 2.5 SD away from the mean were removed in each of the nine conditions to obtain a more normal distribution of reaction times.

To establish whether significant priming was achieved ANOVAs were run on the data with `reaction time` as the dependent variable. The independent variables included the experimental `condition`, `trial type` (control or critical), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). In case of significant results Tukey's Honestly Significant Difference (HSD) was used as a post-hoc test.

Remember that significant translation priming is observed in a condition if we see an effect of `trial type` in the analysis. In other words, if reaction times are significantly faster on primed critical trials than on unprimed control trials, then priming is achieved.

### 4.5.2 Overall Results

Figure 2.14 provides an overview of response times to primed critical trials and unprimed control trials within the nine experimental conditions in the target block. In this figure, and all figures in the following sections, dark bars always represent the unprimed control items, while the light bars represent the critical items that have been primed by a related item in the first block. To foreshadow our results, it can be seen from the figure that significant long-term priming was observed in four of the nine conditions: the ME-TR L1-L2 bilingual condition, the English-only within-dialect ME-ME and PE-

PE conditions, and the within Māori TR-TR condition. No priming is seen in the other three bilingual conditions (PE-TR, TR-ME and TR-PE), while a significant `negative` priming is found in the two English cross-dialect conditions (PE-ME and ME-PE).

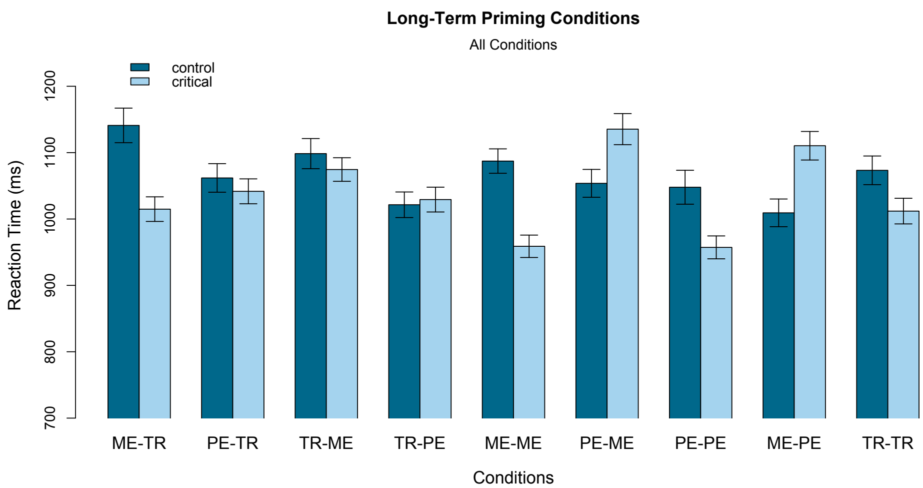


Figure 4.7: Reaction times to control and critical pairs in all nine conditions

The following sections statistically analyze the response times in all of the nine conditions, and investigate any potential effects of trial type, condition, Māori Integration Index, and level of L2 proficiency. I start with the bilingual conditions in Section 4.5.3, followed by the English-only conditions in Section 4.5.4. Finally, I look at the Māori only condition in Section 4.5.5.

### 4.5.3 Bilingual Conditions

An ANOVA was run on the long-term bilingual data with `reaction time` as the dependent variable. The independent variables included `trial type` (control or critical), `condition` (ME-TR, PE-TR, TR-ME, TR-PE), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). A main effect of condition was found (F(3,1316)=3.15, p=.024), which allowed us to further investigate potential significant effects on reaction times within the L1-L2 conditions (ME-TR and PE-TR) and the L2-L1 conditions (TR-ME and TR-PE) separately.

### L1-L2 Conditions

As a next step an ANOVA was run on the L1-L2 data, again with `reaction time` as the dependent variable. The independent variables included `trial type` (control or critical), `condition` (ME-TR, PE-TR), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). Now the `prime variable` could also be included as an independent predictor with the following four levels: final-z, GOAT, GOOSE, and θ. The results revealed main effects of Māori language proficiency (F(1,629)=12.30, p<.001), and trial type (F(1,629)=11.68, p<.001). Significant interactions were found between condition and trial type, and condition and Māori Integration Index. Note, that the prime variable did not show up as significant either as a main effect, or in an interaction with other predictors.

The main effect of Māori language proficiency (F(1,629)=12.30, p<.001) is shown in Figure 4.8. Low proficiency participants take significantly longer to make a lexical decision on Māori language targets, than the advanced L2 speakers. The lack of interaction with condition indicates that this is the case when the Māori language target is preceded by either the ME or the PE translation equivalents in the prime block.

A significant interaction was found between condition and trial type (F(1,629)=5.36, p=.021), which is shown in Figure 4.9. A post-hoc analysis reveals that in the ME-TR condition reaction times are significantly shorter on critical trials than on control trials (Tukey's HSD, p<.001). However, in the PE-TR condition, there is no significant difference in reaction times between critical and control trials. In other words, we get significant priming of Māori language target words when they are preceded by a Māori English translation equivalent in the prime block, but we do not see a priming effect on Māori words when the translation equivalent that was heard approximately 20 minutes earlier was in the Pākehā English variety.

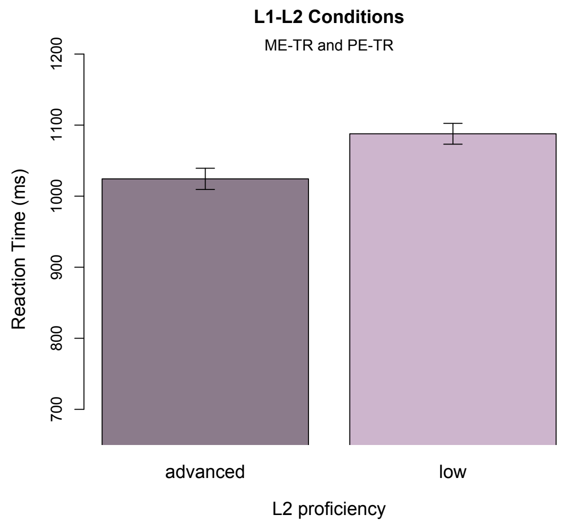


Figure 4.8: L1-L2 conditions - main effect of L2 proficiency.

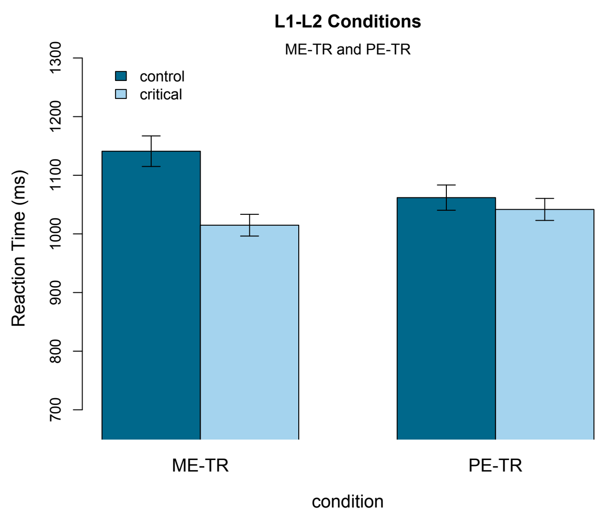


Figure 4.9: L1-L2 conditions - interaction of condition and trial type.

The results revealed a significant interaction between condition and participants' Māori Integration Index (F(1,629)=5.01, p=.025), as shown in Figure 4.10. Post-hoc comparisons indicate a significant difference between reaction times for the highly integrated group across the two conditions. Lexical decisions on Māori language targets take longer for the high MII group when the prime is in Māori English, than when it is in the standard Pākehā English variety (Tukey's HSD, p=.036). For the low MII group there is no overall difference in reaction times between the ME-TR and PE-TR conditions.

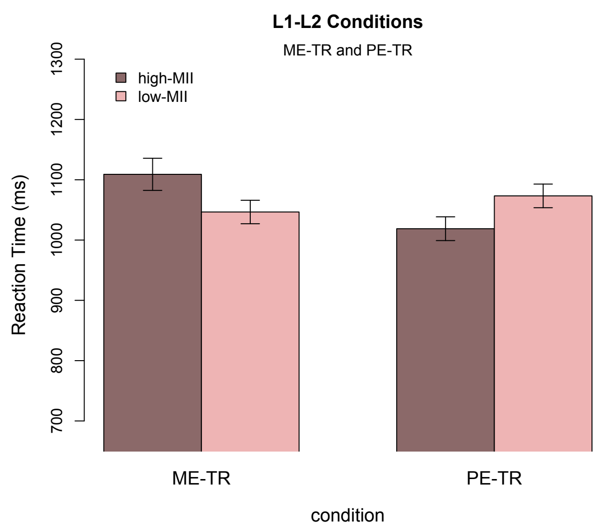


Figure 4.10: L1-L2 conditions - interaction of condition and MII.

### L2-L1 Conditions

Next reaction times in the L2-L1 conditions were examined, where participants were required to make lexical decisions on English language targets after having been exposed to Māori language primes in the first block. The independent variables in the model included `trial type` (control or critical), `condition` (TR-ME, TR-PE), `L2 proficiency` (advanced or low), and `Māori Integration Index` (high or low). The `target variable` was also included as an independent predictor with the following four levels: final-z, GOAT, GOOSE, and θ.

Main effects of condition (F(1,615)=9.00, p<.01) and L2 proficiency (F(1,615)=15.60, p<.001) were found. Crucially, there was no significant effect of trial type, or trial type interacting with condition, indicating that there was no priming effect obtained in either of these L2-L1 conditions in the long-term paradigm. That is, participants do not respond faster to English targets when these targets are preceded by Māori translation equivalents, than when they are preceded by unrelated Māori words. It is also important to note that target variable did not show up as a significant predictor of reaction times in these long-term L2-L1 conditions.

The main effect of Māori language proficiency is shown in Figure 4.11. Overall in these L2-L1 conditions the low proficiency Māori speakers take significantly longer to make lexical decisions on English words, regardless of the dialect of the English target.

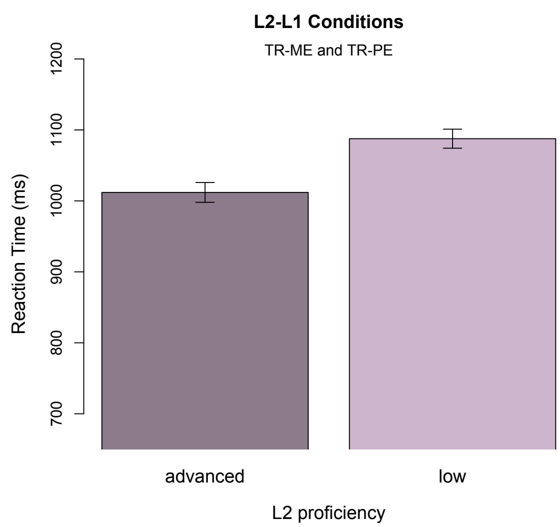


Figure 4.11: L2-L1 conditions - main effect of L2 proficiency.

Figure 4.12 illustrates the main effect of condition in the L2-L1 analysis. Participants are significantly slower to respond to Māori English targets than to targets in the standard Pākehā English variety. Note, that the Māori English target words were significantly longer in duration than the Pākehā English target words (as mentioned in Section 2.3.1), which means it is not possible to tease apart whether this particular main effect of condition has to do with the benefit of processing a standard dialect vs. a non-standard dialect, or simply to do with the length of the target words used in the experiment.

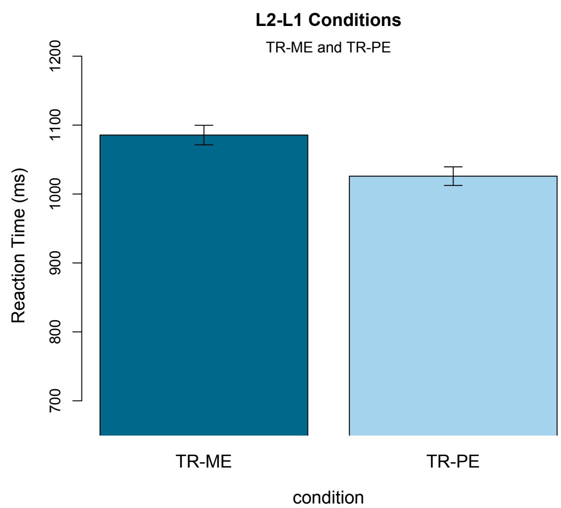


Figure 4.12: L2-L1 conditions - main effect of condition.

### 4.5.4 English Language Conditions

The English-only conditions included four of the nine experimental conditions. First an ANOVA was run on the full set of English-only data, which showed a main effect of condition (F(3,1318)=10.43, p<.001). This allowed us the break down our analysis to examine potential effects on reaction times in the Māori English target conditions on the one hand, and in the Pākehā English targets on the other hand.

### Māori English Targets

In the Māori English target conditions `reaction time` again was used as the dependent variable. The independent variables included `trial type` (control or critical), `condition` (ME-ME, PE-ME), `Māori Integration Index` (high or low), and the `target variable` with the following four levels: final-z, GOAT, GOOSE, and θ. The analysis revealed a main effect of condition (F(1,629)=17.59, p<.001), as well as interactions between condition and trial type, and between participants' Māori Integration Index and trial type. Yet again, there was no significant effect of target variable on reaction times, either as a main effect or in interaction with other predictors.

The results show a significant interaction between trial type and condition (F(1,629)=25.58, p<.001), which is given in Figure 4.13. So far we have seen a number of interactions between trial type and condition in both short-term and long-term experiments, where the critical trials were significantly faster than the control trials (=significant priming effect), or where there was no difference between reaction times to critical and control trials (= no priming effect). However, this is the first time that we observe a significant difference between critical and control trials in the `opposite` direction (=negative priming). In the cross-dialect PE-ME condition responses to critical trials are significantly longer than responses to control trials (Tukey's HSD, p=.025). In other words, having heard a lexical item in the prime block in the Pākehā English variety actively interferes with the processing of that same lexical item in the Māori English variety twenty or so minutes later. In the within-dialect ME-ME condition the post-hoc analysis reveals a significant priming effect, where response times to critical (=repeated) items are significantly faster than to control (=unrepeated) items (Tukey's HSD, p<.001). The results also show that there is no significant difference in reaction times to the control trials in the ME-ME condition and the control trials in the PE-ME condition.

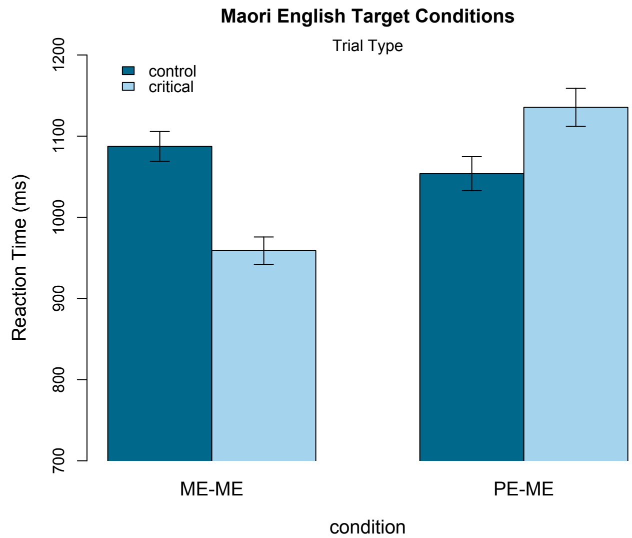


Figure 4.13: ME target conditions - interaction of trial type and condition.

The results revealed a significant interaction between trial type and participants' Māori Integration Index (F(1,629)=4.56, p=.03), indicating that responses to control trials were slower for people who are highly integrated into Māori culture than for the low MII group. The lack of an interaction with condition shows that this is true in both ME-ME and PE-ME conditions, that is, high MII participants are in general slower on unrepeated Māori English items than the low MII participants. However, the highly integrated group responds significantly faster to critical (=repeated) items than they do to control items (Tukey's HSD, p<.05). This facilitation in processing is absent for the low MII group. Figure 4.14 illustrates this interaction.

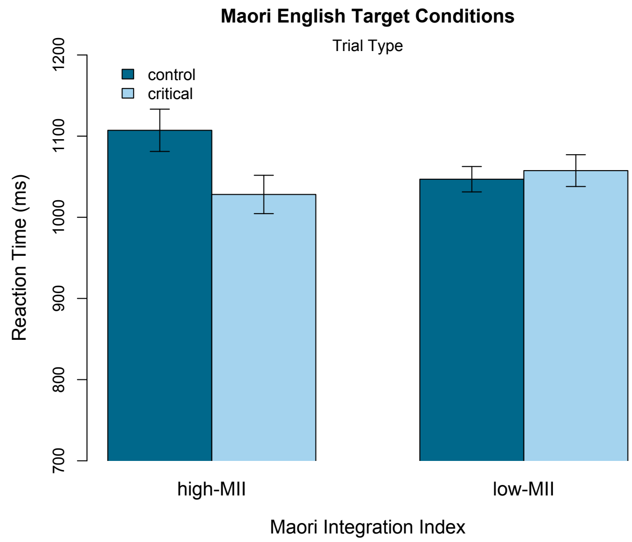


Figure 4.14: ME target conditions - interaction of trial type and MII.

### Pākehā English Targets

`Reaction time` was used as the dependent variable in our ANOVA in the Pākehā English target conditions. The independent variables included `trial type` (control or critical), `condition` (PE-PE, ME-PE), participants' `Māori Integration Index` (high or low), and the `target variable` with the following four levels: final-z, GOAT, GOOSE, and θ. The analysis revealed a main effect of condition (F(1,641)=10.64, p=.0016), as well as interactions between condition and trial type, and between participants' Māori Integration Index, condition, and trial type. Similarly to the other ANOVAs in the long-term experiment, there was no significant effect of target variable on reaction times, either as a main effect or in interaction with any other independent variable.

The results revealed a significant interaction between trial type and condition (F(1,641)=14.34, p<.001), as shown in Figure 4.15. Similarly to the cross-dialect PE-ME condition, we see another case of significant negative priming here in the ME-PE cross-dialect condition. Response times to the critical trials are significantly slower than to control trials in the ME-PE condition (Tukey's HSD, p=.004). This suggests, that having heard a lexical item in the Māori English variety in the prime block interferes with the processing of that same lexical item in the Pākehā English variety twenty minutes later in the target block. In the within-dialect PE-PE condition a significant positive priming effect is observed. Reaction times to critical trials are significantly faster than to control trials (Tukey's HSD, p=.013).

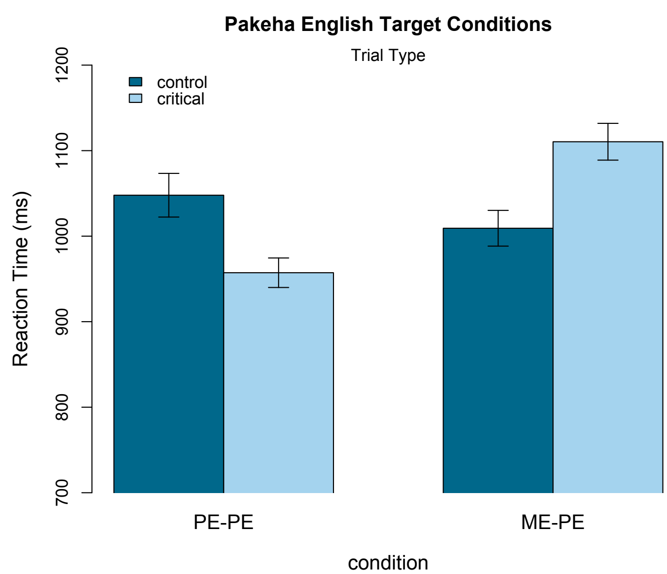


Figure 4.15: PE target conditions - interaction of trial type and condition.

Trial type and condition also showed up in an interaction with participants' Māori Integration Index ($F(1,641)=4.63$), $p<.05$). This interaction is illustrated in Figure 4.16, and shows that the negative priming observed in the ME-PE cross-dialect condition is in fact carried by the high Māori Integration group. This group responds to critical items significantly slower than to control items (Tukey's HSD, $p<.01$). Although the low MII's group responses to critical items are somewhat slower than to control items, this group does not exhibit negative priming. Their responses to critical and control trials do not significantly differ from each other. This suggests that having been exposed to a Māori English word twenty minutes earlier only interferes with the processing of that same word in the Pākehā English variety for people who have a high general exposure to Māori English.

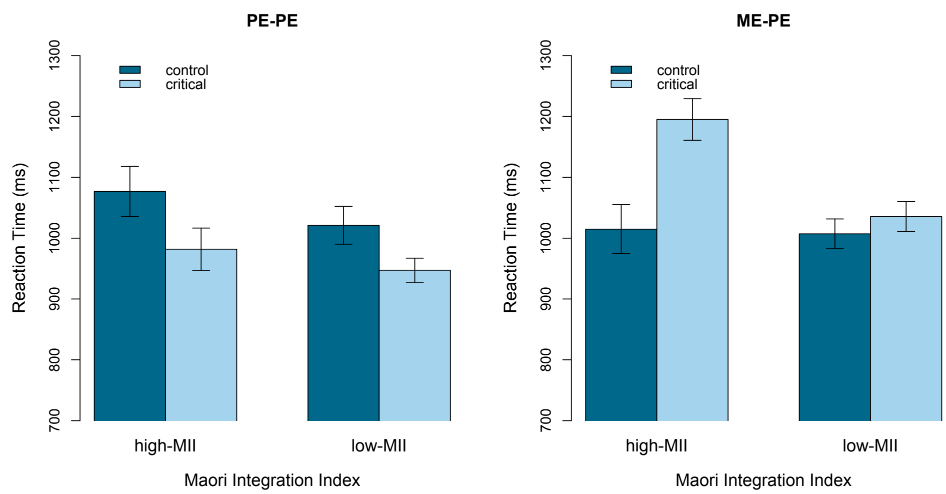


Figure 4.16: PE target conditions - interaction of trial type, condition and MII.

### 4.5.5 Māori Language Condition

The last ANOVA in the long-term experiment was run in the TR-TR condition, which is a L2 repetition priming condition. Critical items consist of Māori words that have been presented in the prime block and are repeated in the target block, while control trials are made up of Māori words that have not been previously heard in the prime block. The dependent variable was once again `reaction time`, while independent variables included `trial type` (critical or control), `Māori Integration Index` (high or low), and `L2 proficiency` (advanced or low). Condition is not included, as this is a single condition. Prime and target variables are also excluded, as there are no English items in this condition.

The results revealed a main effect of trial type ($F(1,329)=4.49$, $p<.05$). This is shown in Figure 4.17, illustrating that participants respond to repeated critical items significantly faster than to unrepeated control items. That is, we see a significant long-term repetition priming effect in the L2. There were no significant effects of participants' Māori Integration Index or Māori language proficiency.

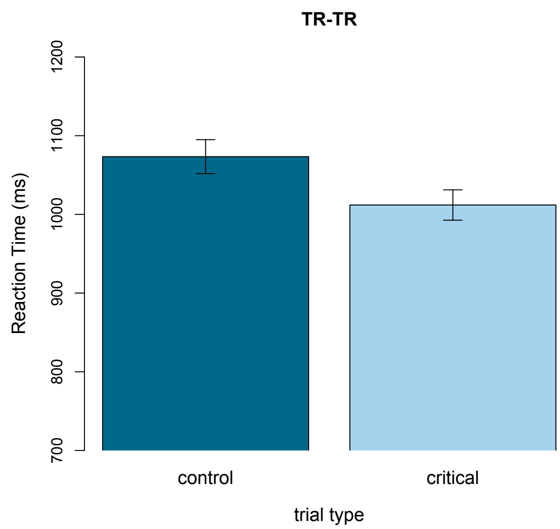


Figure 4.17: TR-TR condition - interaction of trial type.

### 4.5.6 Summary of Reaction Time Results

Significant long-term priming was achieved in four of the nine experimental conditions. Of the four bilingual conditions only one yielded significant priming, namely the ME-TR condition. Here participants made lexical decisions on Māori language targets after hearing Māori English words in the prime block, that were either translation equivalents or unrelated ME words. Response times were significantly faster to Māori words whose translation equivalents had been previously presented. Unlike in the short-term experiment, this was not the case in the other L1-L2 condition. There was no significant priming in the PE-TR condition, meaning reaction times to Māori target words preceded by a Pākehā English translation equivalent were not faster than to unrelated Māori target words. Neither of the L2-

L1 conditions (TR-ME or TR-PE) exhibited significant long-term priming. This is again different from the short-term results, where Māori significantly primed Māori English.

Within-language long-term repetition priming was achieved in the TR-TR condition, as well as the within-dialect English conditions (ME-ME and PE-PE). However, significant negative priming was obtained in the cross-dialect conditions (PE-ME and ME-PE). This suggests that hearing a standard Pākehā English item twenty minutes earlier actively inhibits the processing of the Māori English version of that same lexical item. And vice versa, having been exposed to a Māori English word slows down the processing of that same word in Pākehā English twenty minutes later.

Participants' Māori Integration Index affected long-term priming in the following way. In the L1-L2 bilingual conditions the high MII group took longer to make lexical decisions on Māori words after Māori English primes than after Pākehā English primes. For the low MII group it did not matter whether the prime was in ME or PE. In the English-only conditions, the high MII group was again slower than the low MII group to respond to unrepeated Māori English control items. The results also revealed that the negative priming seen in the ME-PE cross-dialect condition is carried by the group that is highly integrated into the Māori community, while the low MII group shows no (negative or positive) priming in this condition. L2 proficiency had an effect in all bilingual conditions, in that low proficiency Māori speakers took longer to make lexical decisions than the high proficiency group.

One major difference between the results of the short-term and the long-term experiments concerns the role of sociophonetic variables during lexical processing. In the short-term experiment the results showed significant effects of prime and target variables in both bilingual, and within-English conditions. In particular, the innovative and socially salient Māori English GOAT vowel exhibited a special, facilitative role in lexical priming. However, in the long-term experiment the sociophonetic variables demonstrate no effect at all in any of the conditions. That is, none of the phonetic variables affected representation-based priming.

## 4.6 Discussion

### 4.6.1 Long-Term Representations as Part of Social Usage

In a long-term auditory cross-language/cross-dialect priming paradigm using the Māori language and two ethnic varieties of New Zealand English, we found significant long-term priming in four of the nine experimental conditions. These conditions include one L1-L2 bilingual condition where primes were in Māori English and targets were in Māori; two within-dialect English conditions where prime and targets were either both in Māori English, or both in Pākehā English; and the within-L2 condition where both primes and targets came from the Māori language. These conditions have a common theme: the prime and target language varieties are spoken in similar social milieu within New Zealand society. Social environments where the Māori language is spoken are more likely to also feature the Māori English variety rather than the Pākehā English variety. Notice that no priming effects were found in the PE-TR bilingual condition, and negative priming was found in the cross-dialect PE-ME and ME-PE English conditions, where the two language varieties are spoken in different social environments. That is, if the prime word comes from a language variety that does not share a social space with the target language variety, then the prime does not facilitate the processing of the target word, and in fact it can even actively interfere with the processing of the target item.

I interpret these results to suggest that long-term representations between social codes are connected, but not between codes that do not activate the same social category. That is, Māori English successfully primes Māori and Māori English, because the shared social environment unites representations. However, Pākehā English long-term abstract representations do not prime Māori nor Māori English.Thus, the level of abstraction facilitating the priming pattern is based more on social context than on segmental similarity. I argue that shared representations are part of usage and not part of superficial linguistic similarity, such as belonging to the same language.

### 4.6.2 Bilingual Lexical Representation and Social Priming

In the previous section I suggested that long-term abstract representations are united by a shared social environment, and argued that this is the reason why we get significant long-term priming between Māori English and Māori, but not between Pākehā English and Māori. If this reasoning is valid, and social usage is in fact an important part on connecting abstract lexical representations, then we should expect significant priming not only in the Māori English to Māori, but also in the Māori to Māori English direction. However, this was not the case in the L2-L1 direction. Below I describe the mechanisms of a model that still maintains a social link between Māori English and Māori long-term representations, but also accounts for the lack of lexical priming in the L2-L1 direction.

Recall from Section 2.6.1 that both a lemma activation link, and a social category activation link were posited for short-term processing across the L1 and the L2. The same links are assumed here to account for the long-term priming results. In the short-term experiment strong L1-L2 bilingual priming was obtained in the lexical decision task. However, as mentioned earlier, previous research in the visual domain has suggested that long-term cross-language repetition priming is not obtained in lexical decision tasks, rather a conceptually-driven task is needed, such as an animacy-rating task (e.g., Zeelenberg and Pecher, 2003). This suggests that the lemma activation link from L1 to L2 long-term representations is weaker than it is during short-term processing. This weaker link is not strong enough to facilitate lexical processing by itself. However, our results in the long-term experiment do show significant lexical priming from Māori English to Māori. And that is because we also have an active social category activation link from Māori English to Māori, that enhances the effect of the weak lemma activation link between the L1 and L2 long-term representations. I assume that this social link is also weaker than during short-term processing between the L1 and L2. Figure 4.18 illustrates the weak lemma activation links and the weak social category activation link between Māori and the two English long-term representations in the L1-L2 direction.

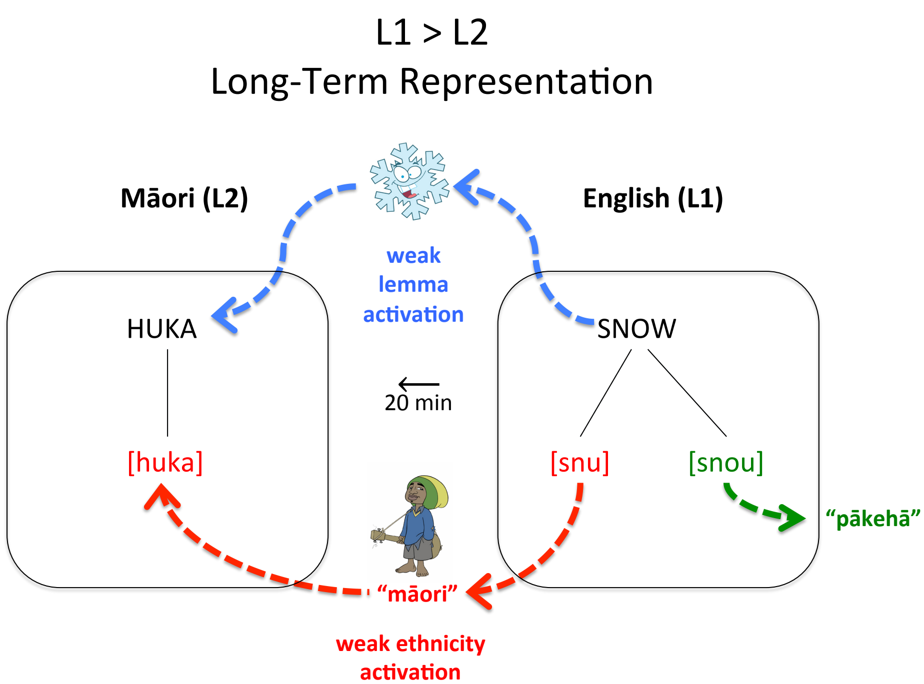


Figure 4.18: Weak lemma activation, and weak ethnicity activation from L1 to L2. Both lemma and social activation are needed for lexical priming.

Returning to our example of the Māori word *huka* and its English translation *snow*, we see weak lemma activation links both between the Pākehā English representation of *snow* and Māori *huka*, and between the Māori English representation of *snow* and Māori *huka*. Upon hearing the L1 Māori English prime [snu], or the L1 Pākehā English prime [snou], the L2 Māori equivalent *huka* is immediately activated. However, the strength of this lemma activation link from the L1 to the L2 significantly decreases in the twenty minute period before the Māori target *huka* is presented to the participant. This weak link alone is not able to achieve long-term priming by itself, hence the lack of priming in the PE-TR condition. However, in the ME-TR condition, on top of the weak lemma activation link Māori English is also connected to Māori through the social category activation link, which - as suggested earlier - also becomes weaker than during immediate short-term processing. However, the effects of the weaker lemma activation link and the weaker social category activation link are additive, and together they can facilitate representation-based priming.

In the L2-L1 conditions our results showed no significant long-term priming in either the TR-ME or the TR-PE conditions. This is not to suggest that that the social category activation link is non-existent in this direction. In fact I argue, that Māori and Māori English are still connected through the same ethnicity activation link as in the L1-L2 direction, rather it is the lemma activation link that is missing in this L2 to L1 direction between long-term representations. This scenario is illustrated in Figure 4.19.

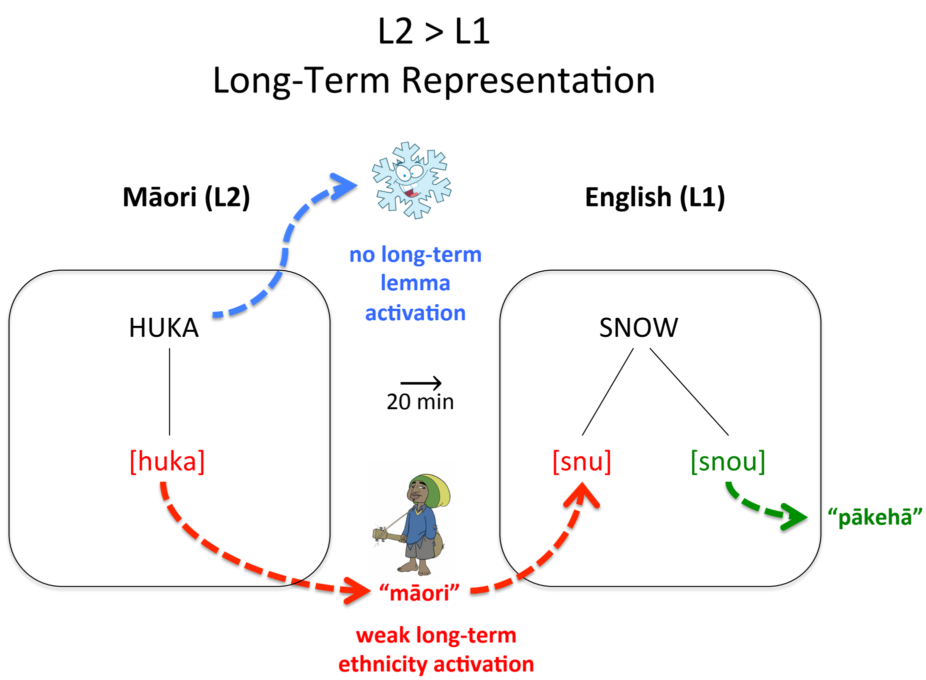


Figure 4.19: No long-term lemma activation, and weak long-term ethnicity activation from L2 to L1. Both lemma and ethnicity activation are needed for long-term lexical priming.

Upon hearing the L2 Māori word *huka* the L1 English lemma *snow* is immediately activated, however, this activation does not survive the twenty minute period before the participant is exposed to the Māori English translation equivalent [snu]. At the same time, on presentation of the Māori prime word *huka* all things Māori have also been activated in the bilingual's mind. I argue that the strength of this social category activation link also decreases over the twenty minute period, but it does not disappear completely. However, this link alone - without the facilitative effect of the lemma activation link - is not strong enough to provide long-term L2-L1 priming in the TR-ME condition. One might wonder why social category activation would persist longer than lemma activation. However, this makes sense in terms of speech processing during the course of a conversation, for example, where many different lexical items become activated all the time, and the lemma activation has to be constantly updated during this process so we can follow the flow of the conversation. People's social categories, however, do not change during the course of a conversation. It is possible that the speaker's style may change, but their individual social categories in terms of age, gender, and ethnicity do not dynamically change during the course of a conversation.

### 4.6.3 Long-Term Representation of Sociophonetic Variables

As mentioned above, one of the main differences between the results of the short-term and the long-term experiments has to do with the behaviour of the sociophonetic variables. Overall we see a stronger connection between Māori English and Māori, than between Pākehā English and Māori during both immediate short-term lexical processing, and as part of long-term representations. The results of the short-term experiment revealed that recent, innovative, and socially salient variants, such as the Māori English GOAT vowel, are most facilitative of social category activation across the L1 and L2 during immediate lexical processing. However, in the long-term experiment none of the phonological variables affected representation-based priming, and in particular, the GOAT tokens did not elicit behaviour that deviates from the patterns of the other three variables. This suggests either that detailed sociophonetic variation is not associated with lexical representations, or that such variables lose their activation levels more rapidly than the general social category they have originally activated.

In the long-term ME-TR condition, for example, upon hearing the Māori English word [snu] with a GOAT vowel that is rather monophthongal and has a fronted onset, all things Māori become strongly activated. As time passes, the exact details of the phonetic material that originally activated the *Māoriness* social category in the listener's mind slowly fade away, but the social associations linked to that phonetic detail persist beyond the detail itself. Although, as I argued above, the social associations themselves become weaker, they do not completely dissipate. Thus, twenty minutes after [snu] was heard, there is still enough strength in the social category activation link to facilitate lexical priming of the Māori target *huka* coupled with the weak lemma activation link.

## 4.7 Chapter Conclusion

This chapter investigated how social information is shared across the L1 and L2 at the long-term representational level. To investigate the effect of ethnic dialect on bilingual language representation, a novel cross-language/cross-dialect long-term auditory priming paradigm was implemented using the Māori language and the ethnic varieties of New Zealand English. Māori and Māori English are more likely to be spoken in similar social environments, while Pākehā English occupies a different social space in current New Zealand society. The results of the experiment demonstrated that long-term L1 to L2 cross-language priming effects can be obtained using a lexical decision task if the two language varieties are associated with the same ethnic category. It was posited that there exists a weak lemma activation link between long-term representations across the L1 and L2, that can be accompanied by a weak social category activation link if the two language varieties share the same social space. I argued that in the opposite direction - from the L2 to the L1 -, the lemma activation link fades away with time, and thus does not exist between long-term representations of L2 and L1 lexical items. However, I suggested that the weak L2-L1 social link persists beyond the lifespan of the lemma link. It was also shown that - unlike during immediate short-term speech processing -, sociophonetic variables do not facilitate representation-based priming. I speculated that the exact details of the phonetic material originally activating a social category in the listeners mind slowly dissipate, but the social associations linked to that phonetic detail persist beyond the lifespan of the phonetic detail itself.

As the focus of this dissertation is the social connections between the L1 and L2, I do not provide an account for the within-English cross-dialect inhibition results. However, future research is planned to further investigate the negative priming results, and to offer a theoretical architecture for cross-dialect interference effects.

# Chapter 5

# Conclusion

## 5.1 General Summary

Psycholinguistic studies on bilingualism frequently investigate how linguistic information is shared between speakers' L1 and L2 at the conceptual level and in the lexicon (e.g., Kroll and Stewart, 1994; Jiang and Forster, 2001; Basnight-Brown and Altarriba, 2007). This focus, along with the nearly standard use of visual tasks, means that phonetic variation has been ignored in the study of bilingual representations. This dissertation intended to bridge this gap. I showed that ethnic categories are shared across the two languages of a bilingual listener by investigating the effect of ethnic dialect on immediate, short-term bilingual language processing, and long-term representation. One focus of this investigation was how innovative phonetic variables are processed in short-term memory and encoded in long-term memory.

The study extended the cross-dialect priming paradigm used in Sumner and Samuel (2009) to a novel cross-language/cross-dialect bilingual paradigm. Independent groups of English (L1) – Māori (L2) bilingual New Zealanders participated in a short-term and a long-term auditory lexical decision task, where critical prime and target pairs were made up of English-to-Māori and Māori-to-English translation equivalents. Half of the English target words were produced by a speaker of standard New Zealand Pākehā English, and half by a speaker of Māori English, thus creating nine test conditions: four bilingual conditions, four English-only conditions (two within dialect, two cross-dialect), and a within-Māori repetition priming condition. Each critical English word contained one of four sociophonetic variables: /θ/, final /z/, and the GOOSE or GOAT vowels. The Māori English GOAT vowel is the most innovative of the four variants, and has a more monophthongal quality and a fronted onset compared to the Pākehā English variant (Maclagan et al., 2009). In the short-term experiment the time interval between a prime and its target was 250ms, whereas the interval was 20–30 minutes in the long-term experiment. The former provided insight into the immediate processing of lexical forms, while the latter shed light on the mental representation of these forms.

Overall, the results revealed a stronger connection between a Māori and Māori English representations than between a Māori and Pākehā English representations both in short-term processing and long-term mental representations. As an explanation, I put forward an argument for the existence of a ethnic category activation link between the L1 and L2, in addition to a lemma activation link at the conceptual level. The strength of these links varies based on the direction of the activation on the one hand, and on the time-course of activation on the other hand. Figure 5.1 summarizes the four scenarios discussed in this dissertation.

During short-term processing in the L1-L2 direction we see a strong lemma activation link, which is alone capable of achieving lexical priming of the L2 target. Independently from this link we also see a strong social category activation link, that can by itself facilitate processing of an L2 lexical item. Evidence for this came from faster processing of not only translation equivalents but also unrelated L2 target words. If both the lemma activation link and the social category activation link are available, the effects of the two are additive. This is why we see a larger magnitude of priming from Māori English to Māori than from Pākehā English to Māori. This is seen in the top left panel of Figure 5.1.

The second scenario, presented in the top right panel in Figure 5.1, is the L2-L1 direction of activation during short-term processing. Here, we see a weaker lemma activation link between Māori and the English translation equivalent. Alone this link does not sufficiently activate the L1 target to achieve significant priming in the L2-L1 direction. However, when the social category activation link is also available, as it is from Māori to Māori English, the coupled effects of the lemma link and the social link result in significant lexical priming. In contrast to the L1-L2 direction, the social category activation link here does not work independently from the lemma activation, rather it enhances the lemma activation's weak effect. This weaker social activation link is only available to those bilinguals who are highly integrated into Māori society and cultural practices.

For the third scenario, that is, activation of long-term representations across the bilingual's two languages, I posited a weak lemma link in the L1-L2 direction, that can be accompanied by a weak social category activation link if the two language varieties activate the same ethnicity. The effects of the two links are additive, and if both are present then we get significant lexical priming. In other words, priming is obtained only for translation equivalents, and only if the prime is in Māori English and the target is in Māori. This is shown at the bottom left panel in Figure 5.1.

In the opposite direction - from Māori to English -, there is no significant priming, regardless of the ethnic variety of the English target word. Māori does not facilitate the processing of Māori English or Pākehā English during long-term processing. Here I argued that the lemma activation link dissipates as time progresses, and thus does not exist between long-term representations of L2 and L1 lexical items. However, I argued that the L2-L1 social link also weakens, but persists beyond the lifespan of the lemma link. Again, as the effects are additive, both the lemma activation link and the ethnicity activation link would be needed to obtain significant priming. This fourth scenario is represented in the bottom right panel of Figure 5.1.

A socially salient, innovative sociophonetic variable was shown to play a major role during short-term processing of speech, but proved to not facilitate long-term representation-based priming. It was speculated that the exact details of the phonetic material that originally activated a certain social category in the listeners mind slowly fade away, but the activation of the social category linked to the phonetic detail survives longer.

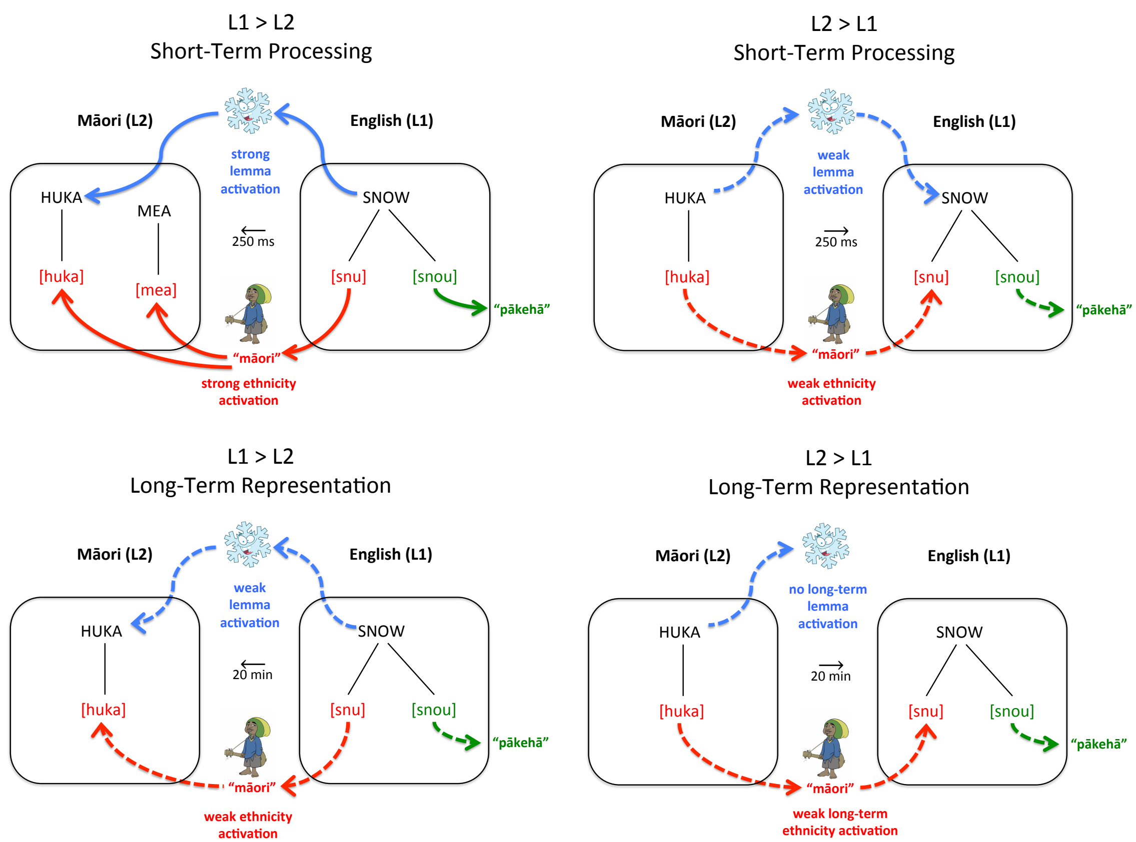


Figure 5.1: Summary of proposed lemma activation links and social category activation links during short-term processing and long-term representation in both L1-L2 and L2-L1 directions.

## 5.2 A Bilingual Instantiation of the Dynamic Interactive Model of Person Construal

Section 1.3.4 presented a dynamic interactive model of person construal, which merges low-level processing of visual and auditory cues with high-level social cognitive phenomena to account for how people perceive other people in an ecologically valid, real-time social environment (Freeman and Ambady, 2011). Here I extend this model to show how social categorization might work in a bilingual situation within the New Zealand context, with excitatory as well as inhibitory connections between social categories across the L1 and L2.

First, I consider how the model categorizes a person as Māori based on some Māori English auditory input in the context of an L1 and L2 lexical decision task. The corresponding diagram is given in Figure 5.2. For simplicity's sake the stereotype level is excluded from this discussion, although previous research has shown that Māori English is stereotypically considered slow, monotonous, hesitant, and low pitched, despite the fact that Māori English pitch is significantly higher than that of Pākehā English (Szakay, 2008). Voice cues nodes are directly activated by the auditory input. In the case of Māori English these nodes can include more creaky voice quality, monophthongized GOAT vowel, syllable-timed rhythm, as well as L1 (=English). These cue nodes then excite category level nodes that are consistent with them, and inhibit category nodes that are inconsistent with them. In this case, all the above mentioned cue nodes have a positively weighted connection to the Māori Category. The L1 cue node excites both the Māori and the Pākehā categories, as English can be spoken by people in both of those categories. Thus, the Pākehā category node is excited by the L1 cue node, but inhibited by all other cue nodes, as Pākehā do not have a monophthongized GOAT vowel, or a syllable-timed rhythm. At the same time as this low-level auditory processing is taking place, higher level input will activate higher level nodes. Because the particular task is a bilingual English and Māori language lexical decision task, there will be an L1 and L2 task demand node at the higher order level, which has excitatory links to both Māori and Pākehā social categories. It is likely that there is also an expectation node, because the experiment is being run as part of a university research study. This would excite the Pākehā category node and inhibit the Māori category node, as the expected English variety within the university is the standard Pākehā variety. However, as the research assistants running the experiment are Māori, this creates a situational context node, which excites the Māori social category and inhibits the Pākehā social category. There is also an inhibitory link between the two social categories themselves. Eventually the system settles into a stable state, with the Māori social category node having a higher activation level than the Pākehā category node. Thus, the outcome is a Māori categorization of the auditory input.

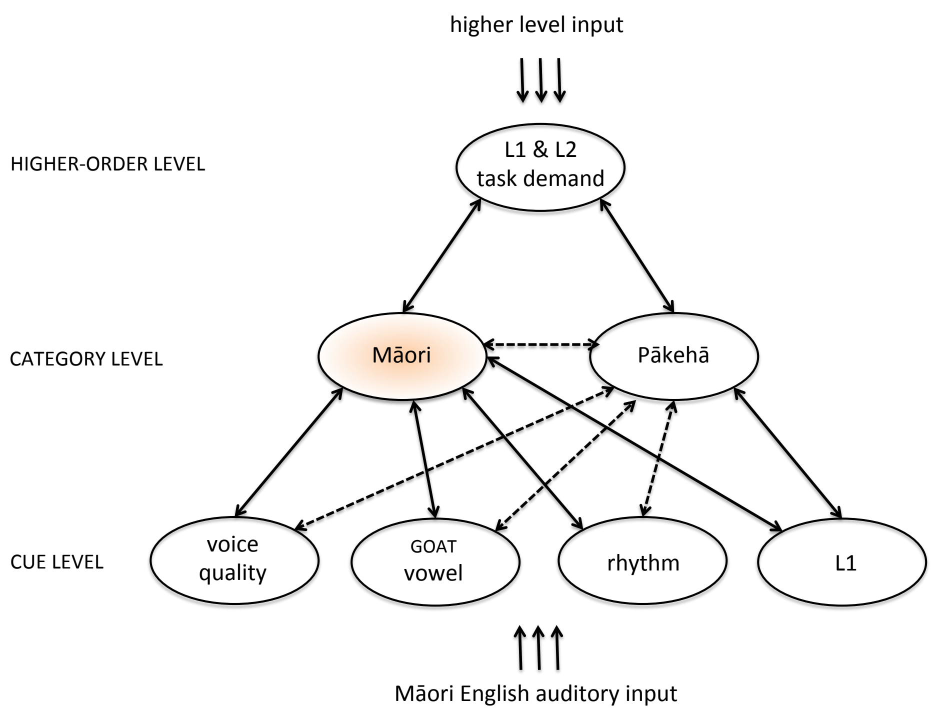


Figure 5.2: An instantiation of the dynamic interactive model of person construal (Freeman and Ambady, 2011) with Māori English auditory input. Solid links are excitatory, dashed links are inhibitory.

Let us now consider what happens when the auditory input is in Pākehā English. The corresponding diagram is given in Figure 5.3. Upon receiving the auditory input, the voice cue nodes are immediately activated. These nodes will include stressed-timed rhythm, diphthongal GOAT vowel, less creaky voice quality, as well as the L1 node. Each of these nodes will excite the Pākehā category node. The Māori category node will get excited by the L1 cue node - as ethnically Māori people also speak English as L1 - but inhibited by all the other cue nodes. The top-down attentional system will activate both the Māori and Pākehā category nodes, similarly to the Māori English case discussed above. The inhibitory link between the two social categories will lower the activation of both. When the model stabilizes it will be the Pākehā social category node that has the higher activation level. This is mainly cased by the greater number of excitatory links from the cue level nodes.

These two cases so far looked at English auditory input. What happens when the auditory input comes from the Māori language? The corresponding diagram for this scenario is given in Figure 5.4. Again, the voice cue nodes are instantly activated from the auditory input. This time the GOAT vowel is irrelevant, but other cue nodes might include Māori rhythm, Māori voice quality, Māori intonation, and the Māori (L2) node. In this case, all the cue nodes excite the Māori category node, and all the cue nodes inhibit the Pākehā category node. In fact, the Pākehā category node only gets excited top-down from the higher-order level nodes, such as the L1 and L2 task demand, and the expectation task demand. Each node dynamically strengthens or weakens before a steady state is achieved. At that point the Māori category node will have a much higher activation level than the Pākehā category node.

The results of the present study suggest that social category activation operates under a shared system across the L1 and L2. The model proposed by Freeman and Ambady (2011) can easily be extended to account for social category activation between the L1 and L2. In a bilingual context, I argue that the social category nodes across the L1 and L2 also have excitatory and inhibitory connections between them. This idea is demonstrated in Figure

5.5. On the left hand side the Māori social category node became activated from a Māori English auditory input through the competition of the different nodes. On the right hand side, after the initial Māori language input the system reached a stable state with the Māori category node having the highest activation level. The two Māori social category nodes are connected through a positively weighted connection, while the connections between the Pākehā and Māori category nodes across the two languages are inhibitory, that is, negatively weighted. As these links are bidirectional, consistent category nodes can activate as well as reinforce one another.

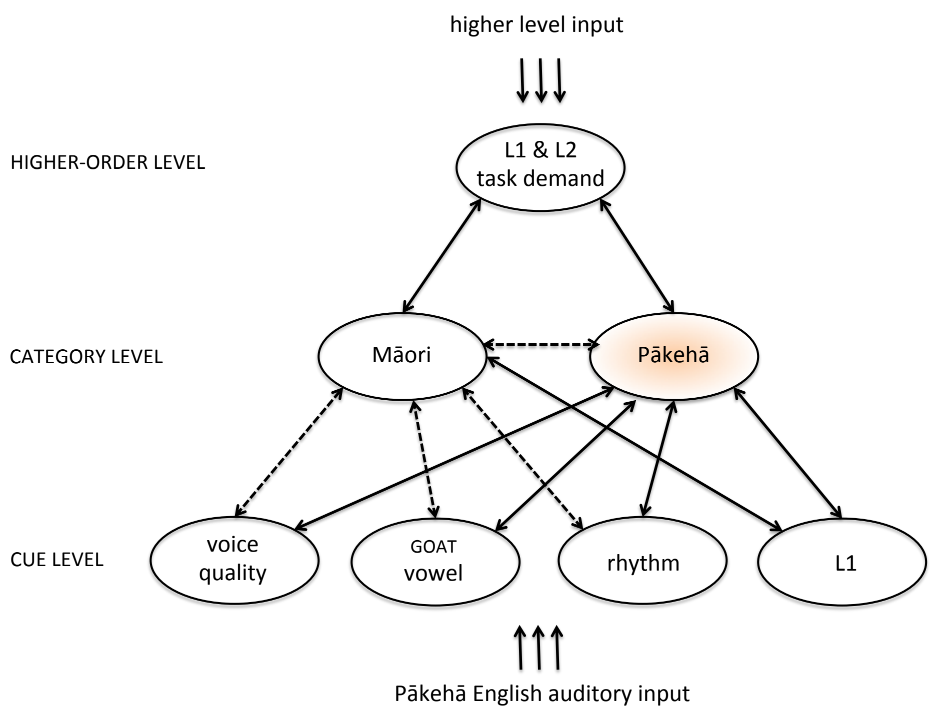


Figure 5.3: An instantiation of the dynamic interactive model of person construal (Freeman and Ambady, 2011) with Pākehā English auditory input. Solid links are excitatory, dashed links are inhibitory.

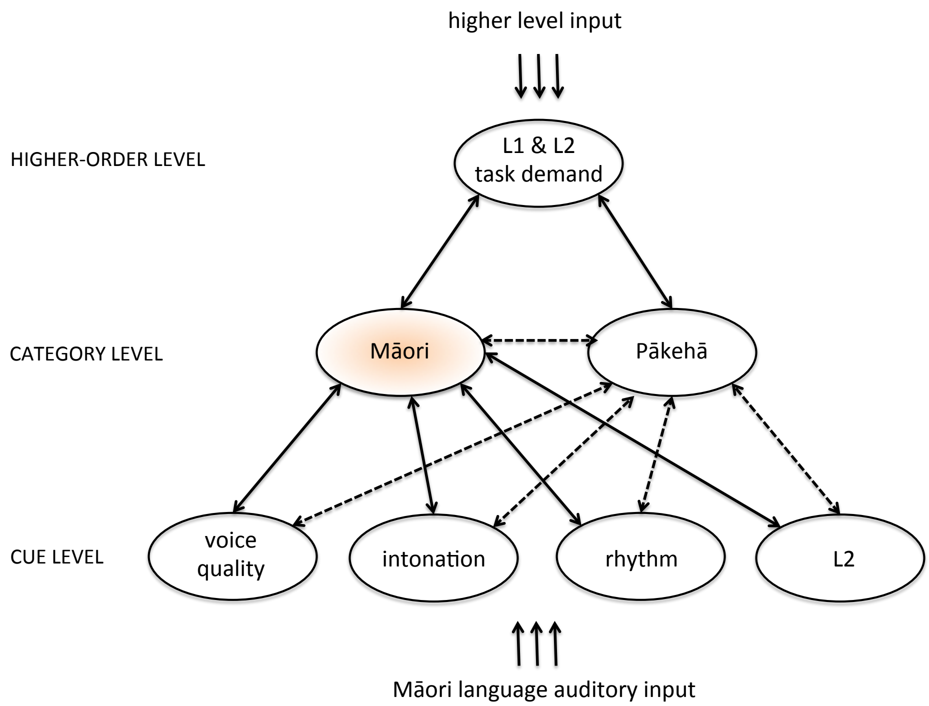


Figure 5.4: An instantiation of the dynamic interactive model of person construal (Freeman and Ambady, 2011) with Māori language auditory input. Solid links are excitatory, dashed links are inhibitory.

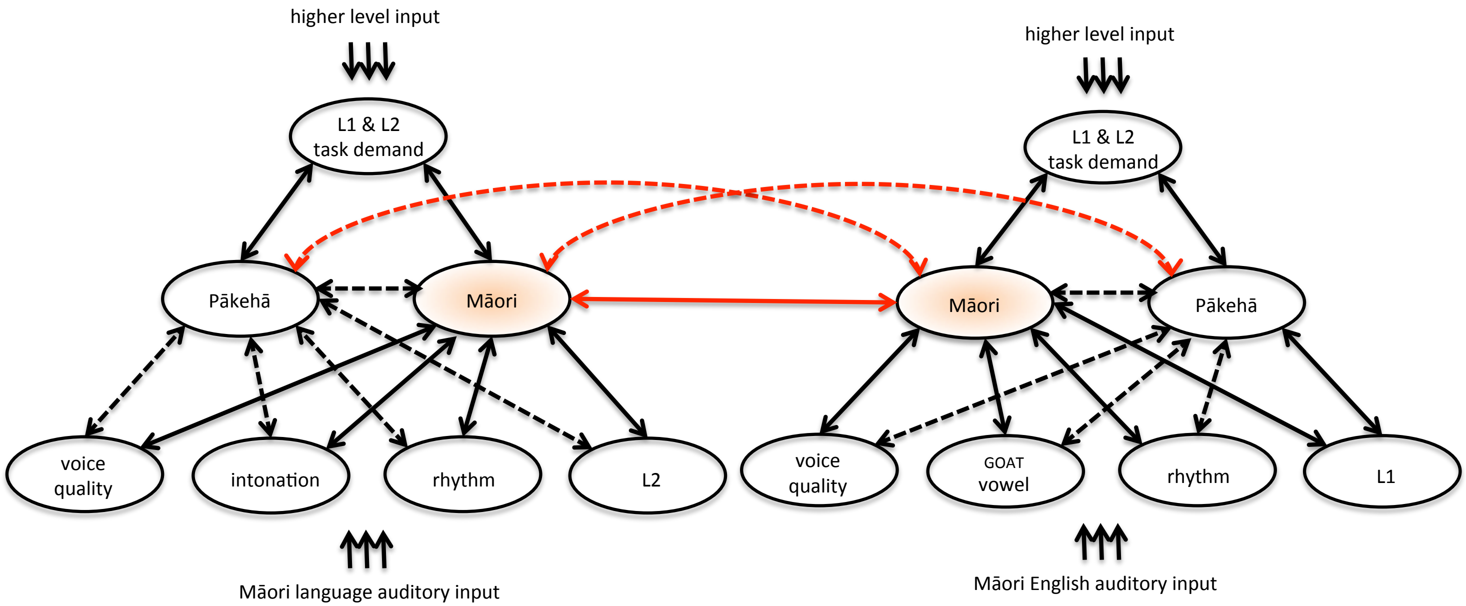


Figure 5.5: An instantiation of the dynamic interactive model of person construal (Freeman and Ambady, 2011) with Māori English and Māori language bilingual auditory input. Solid links are excitatory, dashed links are inhibitory. An excitatory link is proposed between the *Māori* social categories across the L1 and L2, while inhibitory links are proposed between the social categories of *Māori* and *Pākehā* across the L1 and L2.

## 5.3 Remaining Questions and Follow-Up Experiments

The results of this study demonstrated that an innovative sociophonetic variable can facilitate lexical activation during immediate speech-processing, but its own activation level attenuates, and by twenty minutes after the initial activation the effect is gone. The question of just how long is the lifespan of the activation of a sociophonetic variable is an interesting one. Follow-up experiments are now being planned to investigate the time-course of sociophonetic variables with regard to their activation level both in terms of monolingual and bilingual speech processing. In other words, how long does it take before the facilitative effect of the GOAT vowel disappears? It is clearly very active at a 250 ms inter-stimulus interval, however the effect disappears within twenty minutes. Our follow-up studies aim to establish a potential temporal cut-off point for the activation of sociophonetic details within mental representations.

Another issue that needs to be addressed is that of phonetic similarity. To what extent could these results be explained by phonetic similarity alone between Māori English and Māori? Could it be that we see a stronger connection between these two varieties than between Pākehā English and Māori, due to phonetic transfer effects from the heritage language during the development of the Māori English variety? I argue that the answer to that question is no. Recall, that in the long-term experiment the results showed significant priming from Māori English to Māori, but *not* from Māori English to Pākehā English. Since the two English varieties share the same phonological segmental inventories, and are mutually intelligible, we should expect more priming between Māori English and Pākehā English than between Māori English and Māori, if lexical priming was only due to phonetic similarity. However, it is possible that Māori English and Māori share more suprasegmental properties than Māori English and Pākehā English. It has been shown that the two English varieties significantly differ in terms of speech rhythm, mean pitch values, and intonational patterns (e.g., Szakay, 2008), as well as voice quality features (Szakay, 2012). This issue can be investigated by separating out segmental similarity and suprasegmental similarity. By low-pass filtering the speech signal at around 400Hz, we are able to eliminate consonantal and vocalic information from the stimulus, thus we can separate rhythm, intonation, and voice quality from the segmental information itself (e.g., Bezooijen and Gooskens, 1999; Thomas, 2002; Frota et al., 2002; Szakay, 2008). In a similar way, high-pass filtering eliminates prosodic information from the signal (e.g., Lass et al., 1980; Foreman, 2000). By applying low- and high-pass filtering to the prime and target items, it is possible to tease apart the effects of segmental vs. suprasegmental similarity on lexical priming. If suprasegmental priming is obtained, that would crucially suggest that the mental lexicon does not only consist of segmental representations but also includes suprasegmental representations, even in languages that do not use suprasegmental information contrastively. Note, however, that such a result would not necessarily tease apart whether our priming is caused by social categorization or suprasegmental phonetic similarity. And that is because any time one is exposed to that suprasegmental information it is necessarily going to activate the social categories associated with it. In particular, it has been shown that New Zealanders can categorize English speakers as Māori or Pākehā based on suprasegmental information alone (Szakay, 2008). The true test to examine whether our results are due to social category activation or some kind of phonetic similarity will be a cross-modal follow-up priming study. In this paradigm visual material, such as human faces, will be presented as primes, and the study will investigate potential priming effects on lexical targets. I believe that social categories do not just mediate phonetic categories, but can be activated independently. That is, social categorization can happen independently from language. In fact, the interactive model of person construal proposed by Freeman and Ambady (2011) can take both visual and auditory cues as input. Thus, the prediction is that social category priming can be achieved across languages without the explicit use of language per se.

In conclusion, this dissertation research not only contributes to the literature on Polynesian languages, which are undeniably underrepresented in experimental studies, but also provides implications for a number of subfields within linguistics. It informs the field of bilingual psycholinguistics about the effect of dialect on bilingual speech processing and representation. The field of experimental sociophonetics also benefits from this research by finding out about the nature of socio-indexical labelling and social category activation across languages. The study also has potential implications for the field of second language acquisition by demonstrating a processing facilitation between particular L1 varieties and the L2. Finally, this study contributes to the literature within the larger field of laboratory phonology on the nature of perceptual representations. I also hope to have opened up exciting avenues for future interdisciplinary research between these subfields of linguistics, as well as with social cognition theory.

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# Appendix One

The following table lists the 81 critical English–Māori translation equivalents grouped by the sociophonetic variable contained in the English item.

Table 1: The 81 critical English-Māori translation pairs.

| GOAT vowel | | θ | | GOOSE vowel | | final /z/ | |
|---|---|---|---|---|---|---|---|
| blow | pupuhi | earth | papa | blue | kikorangi | applause | pakipaki |
| bone | kōiwi | growth | tipunga | canoe | waka | blaze | mura |
| close /s/ | tata | health | hauora | cartoon | pakiwaituhi | breeze | hau |
| clothes | kākahu | month | marama | chew | ngau | cause | take |
| coast | takutai | mouth | waha | food | kai | choose | whiriwhiri |
| ghost | kēhua | north | tokerau | fruit | hua | cleanse | horoi |
| go | haere | path | ara | gloomy | pōuri | expertise | pūkenga |
| home | kāinga | south | tonga | glue | kāpia | fuse | piri |
| hope | tūmanako | theme | kaupapa | group | rōpū | hers | nāna |
| load | uta | thief | tāhae | include | whakauru | outdoors | waho |
| lonely | mokemoke | thigh | kūhā | move | neke | overseas | tāwāhi |
| open | huaki | thing | mea | movie | kiriata | phrase | kīanga |
| road | huarahi | think | whakaaro | roof | tuanui | quiz | pātaitaitanga |
| rope | taura | third | tuatoru | screw | kōwiri | scissors | kutikuti |
| slow | pōturi | thirsty | hiainu | smooth | māeneene | sneeze | matihe |
| smoke | auahi | thumb | kōnui | soon | wawe | tease | whakatoi |
| snow | huka | thunder | whaitititi | student | ākonga | these | ēnei |
| stone | kōhatu | tooth | niho | tattoo | moko | those | ēnā |
| throat | korokoro | truth | pono | troop | ope | wise | mōhio |
| window | matapihi | youth | taiohi | useless | koretake | yours | nāu |
| yellow | kōwhai | | | | | | |

# Appendix Two

**Māori Integration Index**

Two slightly different scales for Māori and Pākehā subjects are used, with a Pākehā participant being able to score slightly more points for the same answer than a Māori participant. In New Zealand culture, which is a predominantly Pākehā English environment, for a Pākehā participant it takes more of a conscious effort to be involved with the Māori community than for a Māori subject, who is often intrinsically involved. Based on this, Pākehā participants could potentially score an extra half point for each question compared to Māori participants. This excludes the question on the participant's own ethnicity where Pākehā subjects score zero. This way the maximum possible score was 16 for Māori and 17.5 for Pākehā subjects.

**Question 1.** Your ethnicity is:

| | Māori | Pākehā | Other |
|---|---|---|---|
| by Māori | 2 | N/A | 0 |
| by Pākehā | N/A | 0 | 0 |

**Question 2.** If you have a partner, their ethnicity is:

| | Māori | Pākehā | Other |
|---|---|---|---|
| by Māori | 1.5 | 0 | 0 |
| by Pākehā | 2 | 0 | 0 |

**Question 3.** How well do you speak Te Reo Māori?

| | 0 (none) | 1 (basic) | 2 | 3 | 4 | 5 (fluent) |
|---|---|---|---|---|---|---|
| by Māori | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 |
| by Pākehā | 0 | 1 | 1.5 | 2 | 2.5 | 3 |

**Question 4.** How often do you listen to Māori radio stations? (eg. Tahu FM)?

| | never | sometimes | often |
|---|---|---|---|
| by Māori | 0 | 1 | 2 |
| by Pākehā | 0 | 1.5 | 2.5 |

**Question 5.** How often do you watch The Māori Television or other Māori TV programmes?

| | never | sometimes | often |
|---|---|---|---|
| by Māori | 0 | 1 | 2 |
| by Pākehā | 0 | 1.5 | 2.5 |

**Question 6.** Do you ever visit a marae?

| | never | sometimes | often |
|---|---|---|---|
| by Māori | 0 | 1 | 2 |
| by Pākehā | 0 | 1.5 | 2.5 |

**Question 7.** People you spend most of your time with (friends, colleagues etc...) are:

| | Māori | Pākehā | Pasifika | Other |
|---|---|---|---|---|
| by Māori | 2 | 0 | 0 | 0 |
| by Pākehā | 2.5 | 0 | 0 | 0 |

**Question 8.** In general, to what extent do you perceive yourself to have been exposed to Māori English?

| | never | seldom | sometimes | often |
|---|---|---|---|---|
| by Māori | 0 | 0 | 1 | 2 |
| by Pākehā | 0 | 0 | 1.5 | 2.5 |