12-7-2018 10:00 AM

Conceptual Representation in Bilinguals: A Feature-Based Approach

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A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy

Abstract

A challenge for bilinguals is that translation equivalent words often do not convey exactly the same conceptual information. A bilingual exhibits a “semantic accent” when they comprehend or use a word in one language in a way that is influenced by knowledge of its translation equivalent. Semantic accents are well-captured by feature-based models, such as the Distributed Conceptual Feature model and the Shared (Distributed) Asymmetrical model, however, few empirical studies have used semantic features to provide direct evidence for these models. The goal of this thesis is to use a feature-based approach to identify conceptual differences in translation equivalent words and to investigate how word meanings are activated in sequential Japanese-English bilinguals in their L1 and L2. In Chapter 2, I collected feature norms from Canadian English speakers and Japanese speakers for translation equivalent words to identify whether conceptual differences can be detected from a feature production task. Based on a cross-language comparison of the two feature norms, differences were identified in both global (i.e., the overall proportion of production frequency for different knowledge type) and individual feature levels (i.e., language-specific features). These findings suggest that a feature-based approach is useful to identify conceptual differences in translation equivalent words. In Chapter 3, I used language-specific semantic features (e.g., “is yellow” for the word BUS) to investigate whether language-specific conceptual information is activated differently (1) between bilinguals and monolinguals, (2) depending on the task of the language (L1 vs L2) within bilinguals, and (3) depending on bilinguals’ individual differences including L2 proficiency and the extent of L2 cultural immersion. Both explicit and implicit behavioural tasks were used to explore how bilinguals access language-specific conceptual information when they are processing words in their L1 and L2. The comparison between bilinguals and monolinguals revealed that bilinguals exhibit semantic accents in both of their L1 and L2. The comparison between L1 and L2 tasks within bilinguals revealed that language-specific features were activated at different strengths depending on the language of the task. Finally, the results suggest that the nature of accents depended more on the extent of L2 cultural immersion rather than L2 proficiency.

Keywords

Bilingualism, language, semantic features, semantic feature norms, conceptual representation, cultural immersion

Acknowledgements

First and foremost, I would like to express my sincere gratitude to my supervisor, Debra Jared. Without her generous support and guidance, it would not be possible to complete my thesis. I am especially thankful for her patience and constructive feedback during the completion of my thesis. I would also like to thank my advisory committee, Ken McRae and Paul Minda. Your feedback was invaluable. Special thanks to Yasushi Hino, Masahiro Yoshihara, and Keisuke Ida for their advice and help on the data collection in Japan. Finally, my great appreciation goes to my family, especially Kazunaga Matsuki, for continuously supporting me to complete my thesis.

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1 General Introduction

It is estimated that more than half of the world's population speak more than one language (Grosjean & Li, 2013). While interest in bilingual research has been increasing substantially for the past few decades, there are several common misconceptions in the general public about how languages are represented and processed in the bilingual mind. For instance, one assumption is that proficient bilinguals use each of their languages in much the same way that monolinguals use their language. That is, when bilinguals comprehend and produce information in one of their languages, they only activate the relevant information in the language they are actively using at the moment. However, this assumption is not the case. A number of studies indicate that bilinguals activate information from both of their languages simultaneously even when they are using only one of their languages (e.g., Dijkstra, Van Heuven, & Grainger, 1998; Grainger & Dijkstra, 1992; Misra, Guo, Bobb, & Kroll, 2012; Wu & Thierry, 2010). Furthermore, it has also been observed that the two languages interact with and influence each other such that the activation of the non-target language facilitates, and at other times interferes with, the processing of the target language (e.g., Jared & Kroll, 2001; Kroll & Stewart, 1994; Nakayama, Sears, Hino, & Lupker, 2013). This cross-language interaction occurs at various levels of language representation and processing (e.g., phonology, grammar, semantics), leading bilinguals to use and comprehend a language somewhat differently from their monolingual counterparts. Such deviation from monolinguals due to the knowledge of other languages is referred as an "accent" (De Groot, 2014).

Accents are most frequently discussed with respect to the phonology of languages. For example, many Japanese-English bilinguals who have Japanese as their first language (L1) show difficulties perceiving and pronouncing "rock" and "lock" differently because there is no phonological distinction recognized between "r" and "l" in Japanese (MacKain, Best, & Strange, 1981; Strange & Dittmann, 1984). While phonological accents are typically observed in bilinguals' second languages (L2), there are also cases where they develop accents in their L1. In a study by Yeni-Komshian, Flege, and Liu (2000), Korean-English bilinguals who immigrated to the U.S were asked to repeat Korean sentences, and their pronunciations were compared to those from monolingual Korean speakers residing in Korea. The degree of their accents was later rated by native Korean speakers, and the researchers found that all bilinguals were rated as having at least some accent in their pronunciation of Korean, even though it was their first language.

A similar phenomenon is also observed in the domain of grammar. Bilinguals often incorporate grammatical features from one language when they are using the other language. For example, Chinese-English bilinguals might say “I enjoy the party last night” instead of “I enjoyed the party last night”. The omission of the past tense inflection is considered as a grammatical accent because Chinese does not have grammatical markers of tense (Basnight-Brown, Chen, Hua, Kostic, & Feldman, 2007; Nicoladis, Song, & Marentette, 2012). Grammatical accents are also observed when bilinguals use their native language. Dussias (2003) demonstrated that Spanish-English bilinguals who immigrated in the U.S resolved ambiguous Spanish (L1) sentences in a way that was more similar to English monolingual speakers than to Spanish monolingual speakers. For example, when given an ambiguous sentence such as “Someone shot the son of the actress who was on the balcony”, Spanish monolinguals tended to refer back to the first noun “son” (N1 attachment) when asked who was on the balcony, while English monolinguals tend to refer back to the second noun “actress” (N2 attachment). The researchers found that the Spanish-English bilinguals resolved the ambiguity with N2 attachment regardless of the language of the sentences. These results suggest that their Spanish (L1) sentence processing has an accent that is caused by their grammatical knowledge of English (L2).

While phonological and grammatical accents are commonly discussed, bilinguals also exhibit accents in their use of lexical conceptual knowledge. De Groot (2014) referred to this circumstance as a semantic accent. Generally, semantic accents are relatively less well known compared to the other two types of accents that were discussed above. However, they are as prevalent as the other two types of accents because a word in one language often does not have a perfectly matching translation equivalent word in another language. Although translation equivalent words are generally considered to have a comparable meaning, some conceptual differences can exist in both concrete and abstract words, and is true even if the two languages are closely related, such as English and French (Van Hell & De Groot, 1998). As an example, the word “ball” in English is typically translated as “balle” in French. The two words, however, do not refer to the same category of objects because the word “balle” refers to small balls such as tennis balls, but not to basketballs or footballs (Paradis, 1997). Thus, when English-French bilinguals use “balle” to refer to a basketball with the assumption that the word means the same as “ball,” they are exhibiting a semantic accent. The fact that translation equivalent words often do not convey exactly the same conceptual information can pose challenges, particularly for sequential bilinguals, who start learning their second language (L2) after their first language (L1), because they often learn new L2 words through translations.

The difference in semantic knowledge of translation equivalent words can also come from contextual circumstances, especially when the two languages are used in different cultures (Athanasopoulos, 2015; Lupyan & Lewis, 2017; Masuda, Ishii, Miwa, Rashid, Lee, & Mahdi, 2017; Paivio, 2007; Pavlenko, 2009). For example, the English word “pumpkin” is translated as “kabocha” in Japanese, but the actual objects look and are used differently depending on cultural contexts. In North America, pumpkins are typically orange and used for carving jack o’lanterns. On the other hand, typical pumpkins in Japan have green skins and are not used for carving (since Halloween is not common). Thus, if a Japanese-English bilingual activates “green” when they process the English word “pumpkin”, this would be an example of a semantic accent. Accents that arise from such cultural differences raise an interesting question as to whether bilinguals develop lexical conceptual representations differently depending on where they learn and use their languages. In other words, bilinguals with a similar level of language proficiency may possess different conceptual representations for the same words depending on their degree of immersion in the L2 cultural environment.

Another research question concerning semantic accents is whether or not bilinguals activate the same meanings for translation equivalent pairs. The answer to this question has implications for the issue of whether bilinguals have a common or separate lexical stores for their two languages, which has been one of the central issues in the bilingual literature. If bilinguals have a shared lexical store, they may activate the same meanings for translation equivalent words regardless of the language they use. On the other hand, it might also be the case that language-specific information (e.g., “is yellow” for BUS) remains relatively independent from the other language. In such a case, bilingual conceptual representations would be asymmetrical, meaning that bilinguals activate somewhat different meanings for translation equivalent words depending on the language.

Although semantic accents seem to be a critical phenomenon that characterizes bilingual language processing, they have not been well investigated, possibly because the semantic differences among translation equivalent words are generally subtle and difficult to grasp. The goals of my dissertation are (1) to empirically identify conceptual differences between translation equivalent words by collecting feature norms (Chapter 2) and (2) to investigate how bilinguals develop and activate conceptual representations of translation equivalent words using semantic features (Chapter 3). In the following sections, I will review the existing bilingual models with the relevant studies to evaluate how they explain semantic accents, discuss the advantages of a feature-based approach to understanding bilingual conceptual representation, factors that can impact bilinguals' conceptual development, and finally I will describe the specific objectives of my research.

1.1 Current Bilingual Models

1.1.1 Dual Coding Theory

An important theory in monolingual studies of conceptual representation is Dual-Coding Theory (Paivio, 1971). Dual-Coding Theory assumes that the concepts are encoded in two modality-specific systems: nonverbal (imagen) and verbal (logogen). Imagens represent perceptual information and logogens represent linguistic information. Paivio and Desrochers (1980) extended this theory to bilinguals. Bilingual Dual-Coding (BDC) theory has separate verbal systems for each language, although translation equivalents are connected to each other. These two verbal systems are each connected to the nonverbal system. A pair of translation equivalent words can be connected either to shared or separate imagens, depending on the similarity of the contexts in which the two languages are learned. For example, if both languages are learned simultaneously and in the same cultural environment, the two logogens of a translation equivalent pair would develop connections to common imagens. On the other hand, if the languages are learned at different times and in different cultural environments, they are more likely to develop connections to different imagens, even if they are translation equivalents. Thus, this model suggests that bilinguals develop conceptual representations for their two languages differently depending on how those languages are learned.

The idea that translation equivalent words can be connected to language-specific imagens is supported by several studies. Jared, Poh, and Paivio (2013) showed Chinese-English bilinguals images of objects that are typical either in Canada or China. For example, participants saw a photo of a post box, which was either red and rectangular (typical in Canada) or green and cylindrical (typical in China). When the bilinguals were asked to name the object, they responded faster when the visual image and the language of the task were culturally congruent (e.g., saw the Canadian post box and named it in English) compared to when it was completed in a culturally incongruent language (e.g., saw the Canadian post box and named it in Chinese). Similarly, Zhang, Morris, and Cheng (2013) reported that Chinese-English bilinguals had more difficulty speaking in English (L2) when they described visually presented Chinese (L1) cultural icons compared to when they described American ones, suggesting that icons that are specifically relevant in one culture have weak connections to the culturally incongruent language.

These findings provide evidence that even if they are translation equivalent words, bilinguals activate somewhat different meanings depending on the language being used, suggesting that language-specific conceptual information is not equally connected to both languages. Instead, they support the idea of BDC theory that bilinguals who have learned two languages in different cultural contexts develop asymmetrical conceptual representations that can be connected more strongly to one language than the other. On the other hand, the theory assumes that this would not be the case when the bilinguals learn those languages in the same cultural context. If this claim is true, then Chinese-English bilinguals who have only been exposed to Chinese culture may develop a common conceptual representation for translation equivalent words. Such a circumstance would lead them to possess semantic accents in their English (L2), because they would have less L2 cultural exposure and therefore would be much less likely to develop different imagens for each language. While this prediction has not been empirically tested, it taps into an important issue concerning the influence of learning contexts on bilinguals' lexical conceptual representations.

1.1.2 Distributed Conceptual Feature Model

A prominent view in the research on conceptual knowledge representation in monolinguals is that the meaning of words is represented, at least partially, in terms of semantic features (e.g., "barks" for the concept dog), and a number of studies have shown the usefulness of features in explaining various behavioural and neuropsychological phenomena (Barsalou, 1982; Collins & Quillian, 1969; Minsky, 1975; McRae, de Sa, & Seidenberg, 1997; Norman & Rumelhart, 1975; Rogers & McClelland, 2004; Shallice, 1988). This view of concepts has been implemented in computational models that can simulate how concepts are acquired and how conceptual representations change over the course of development. Because these models generate quantitative values that can be mapped onto some aspect of human behaviour, comparisons between a model simulation and behavioural data can provide insights about the mechanisms of conceptual processing. For example, Cree, McRae, and McNorgan (1999) simulated semantic priming between concepts with similar features (e.g., eagle and hawk) in a model in which the similarity of concepts was represented in terms of overlapping semantic features.

Adopting this notion of feature-based representation of concepts from the monolingual literature, DeGroot and colleagues (De Groot, 1992; Kroll & De Groot, 1997; Van Hell & De Groot, 1998) have proposed the Distributed Conceptual Feature (DCF) model of bilingual conceptual representation. According to this model, conceptual information is stored in terms of feature units, and those feature units are connected to word forms. Because translation equivalent words (e.g., "dog" in English and "chien" in French) typically convey comparable meanings, they are assumed to activate mostly the same feature units (e.g., has four legs, barks, and kept as a pet). The subtle differences in meaning between translation equivalent pairs are assumed to be reflected in the unique subset of features that each word activates.

DeGroot and Poot (1997) claimed that concrete translation equivalent words (e.g., father [English] and vader [Dutch]) are more likely to share common features compared to abstract translation equivalent words (e.g., idea [English] and idee [Dutch]). This claim has been supported by a study with Korean-English bilinguals (Jin, 1990) showing a cross-language translation priming effect for concrete words but not for abstract words. Jin's finding suggests that concrete translation equivalent words indeed share more common features than abstract words. However, because abstract words generally take more time to process compared to concrete words (Schwanenflugel, 1991), the lack of priming effect for abstract words may be due to ceiling effects. More recent translation priming studies found no effect of concreteness (Chen, Liang, Cui, & Dunlap, 2014; Francis & Goldman, 2010). Additionally, Oshaka (2012) claims that many abstract words in fact refer to very similar meanings across languages, indicating that the extent of shared conceptual features is likely to depend on the choice of words. As such, evidence for the DCF from studies using the concrete/abstract distinction is not convincing.

Stronger support for the DCF model comes from bilingual object naming studies. For example, Ameel, Storms, Malt, and Sloman (2005) argued that the DCF model provides a good framework to explain lexical categorization in bilinguals. In their study, Dutch-French simultaneous bilinguals were asked to name 73 images of containers. Some of the containers used in the study were categorized differently between monolinguals of each language. For example, two of the containers in the set are usually labelled differently in French (e.g., one is called a *bouteille* and the other is called a *flacon*), but both containers are called *fles* in Dutch. Ameel et al. observed that bilinguals' naming patterns for their two languages were more similar to each other compared to the naming patterns observed in monolinguals of the two corresponding languages. Thus, bilinguals may use *bouteille* for both the *bouteille* and the *flacon* when naming in French, suggesting that they verbally categorize them more similarly than French monolinguals. The researchers hypothesized that the reason bilinguals' naming patterns converge across languages is that their lexical conceptual representations were simplified by either dropping language-specific features or generalizing those features to both languages. This view provides a specific account for the mechanism of semantic accents. Specifically, bilinguals may develop semantic accents by generalizing language-specific features to both languages or dismissing those features.

While the DCF model provides an account for how semantic accents may arise, few studies to my knowledge have empirically tested the claim by focusing on individual features that may be generalized or dropped in the process of becoming bilingual. This is particularly important given that some researchers claim that the feature-based approach is not suitable for studying conceptual representation (Paivio, 2007, Pavlenko, 2009). Therefore, it is essential to empirically evaluate whether conceptual differences in translation equivalent words can be observed in terms of features. One reason for the lack of such empirical validation attempts might be due to the lack of specificity of the DCF model's assumptions. While the model can explain how bilinguals' conceptual information may be represented, it provides little insight as to how they develop such representations, such as how the representations may be influenced by different factors, including language proficiency and learning contexts. In the next section, I discuss another feature-based model with a developmental account.

1.1.3 Shared (Distributed) Asymmetrical Model

The Shared (Distributed) Asymmetrical (SDA) model (Dong, Gui, & MacWhinney, 2005) may be one of the most compelling models that accounts for bilingual conceptual representation. The SDA model addresses most of the issues raised in the two models discussed above, including semantic accents, conceptual asymmetry, and development. In this model, concepts are represented as elements of information whose connections to words are assumed to change depending on bilinguals' L2 proficiency. Translation equivalent words are assumed to have links to both shared and language-specific elements. For example, the word *pumpkin* and the Japanese translation *kabocha* may share common conceptual elements such as "is round"; other elements such as "is green" are considered as language-specific because they are relevant in the Japanese context but less typical in North America. Thus, the model does not assume that translation equivalent words activate the same conceptual elements, making the links between the words and conceptual elements asymmetrical.

While the basic structure of connections between words and conceptual elements is similar to the DCF model, the SDA model provides specific predictions regarding how L2 proficiency influences the connection strengths between them (see Figure 1.1). More specifically, the model assumes that bilinguals with low L2 proficiency acquire a new L2 word not by learning L2 conceptual elements at the same time, but rather by developing connections to the conceptual elements they already know from their L1. For example, Japanese-English bilinguals may learn the word *pumpkin* assuming that it conveys the same semantic information as the Japanese *kabocha*. That is, the bilinguals may assume that the English word *pumpkin* refers to a round vegetable with green skin, without knowing that it can be used for carving jack o'lanterns.

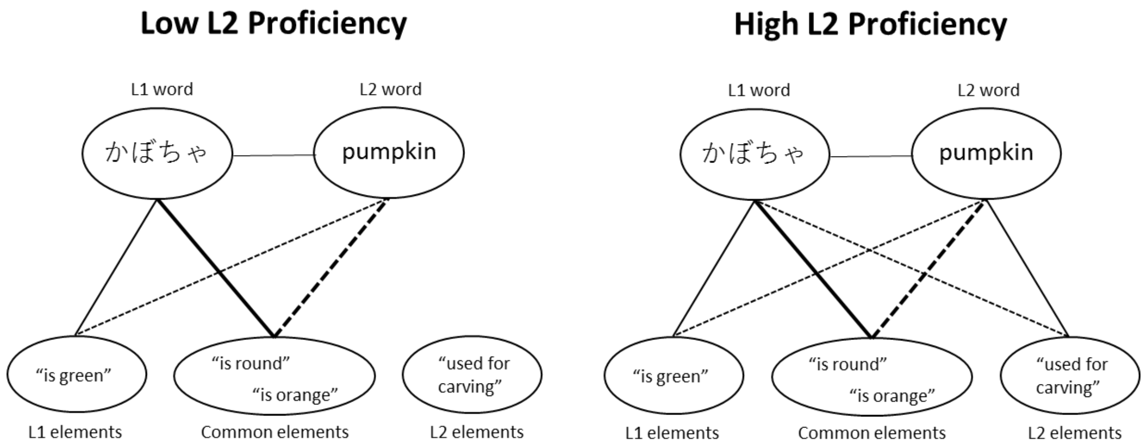

Figure 1. 1. The Shared (Distributed) Asymmetrical (SDA) model. The SDA model proposes that conceptual representations differ in L1 and L2 depending on L2 proficiency.

This causes them to develop semantic accents in their L2 because the word *pumpkin* would activate the L1-specific element "is green". This overextension of L1-specific elements to L2 words is similar to one of the mechanisms of semantic convergence discussed in Ameel et al. (2005). However, the proposal of the SDA model differs in that the semantic representations activated by the L2 word are initially solely based on knowledge from L1. The model assumes that sequential bilinguals are likely to initially overextend L1-specific elements when they process L2 words and therefore activate somewhat different meanings of words than monolingual speakers of the L2. The SDA model further proposes that as L2 proficiency develops, bilinguals form connections between L2 words and L2-specific conceptual elements, and weaken the connections between L2 words and L1-specific elements, lessening the semantic accent in L2. These processes lead bilinguals to have somewhat different conceptual representations for translation equivalent words, which is referred to as conceptual asymmetry. However, the SDA model also proposes that the acquisition of L2-specific elements can result in bilinguals developing weak connections between L1 words and L2 elements (e.g., *kabocha*, used for carving jack o'lanterns), producing a semantic accent in L1. Such connections produce semantic convergence in bilinguals, where the meanings activated by *kabocha* (L1) and *pumpkin* (L2) are more similar compared to those activated by monolinguals of each language. That is, Dong et al. suggest that there are mechanisms that produce both convergence and divergence of the representations activated by translation equivalent words. While these mechanisms can also be accommodated in the DCF model, an advantage of the SDA model is that it makes specific predictions about how bilingual conceptual representations may change depending on bilinguals' proficiency.

Dong et al. (2005) tested the predictions of their model by asking participants to rank the semantic similarity between a head word (e.g., *red*) and eight other words (e.g., *debt, bride, color,* etc.). Some of the relations were culturally-specific (e.g., *red* and *bride* are related in a Chinese context because a red wedding dress is common in China but not in North America). The task was completed by Chinese-English bilinguals who varied in English proficiency (university students in China who were first- or third-year English majors), as well as Chinese monolinguals and English monolinguals. When the task was completed in English (L2), the researchers found that the ranking pattern of the less proficient bilinguals deviated more from English monolinguals than did the ranking pattern of the more proficient bilinguals. The researchers argued that this difference supports the idea that low proficiency bilinguals have less English monolingual-like conceptual representations because they are more dependent on their L1 knowledge. On the other hand, when the task was done in Chinese, the ranking pattern of the high proficiency bilinguals deviated from Chinese monolinguals more than that of low proficiency bilinguals. The researchers explained that this occurred due to the influence from the acquisition of L2 conceptual elements. That is, L2 conceptual elements not only connected to L2 words, but they also developed links to L1 words.

These findings from Dong et al. (2005) suggest that less proficient bilinguals have stronger semantic accents in their L2 compared to more proficient bilinguals, while high proficient bilinguals have stronger semantic accents in their L1 compared to low proficiency bilinguals. Furthermore, the researchers also found that bilinguals tended to maintain the conceptual differences of the translation equivalent words to some extent. That is, even if some of their conceptual representations converge due to the influence from the other language, it does not lead bilinguals to have completely shared conceptual representations that are equally accessed by either language. Instead, the researchers found that even highly proficient bilinguals activate somewhat different meanings for translation equivalent words depending on the language of the task. Therefore, they argue that bilinguals have both shared and language-specific conceptual representations, where the links between words and language-specific conceptual representation are susceptible to change depending on proficiency in their second language. While the SDA model provides a developmental account, there have been few follow-up studies conducted to provide further evidence, possibly because a feature-based approach has rarely been used in the bilingual literature. Furthermore, unlike the BDC theory, the effect of L2 learning context was not mentioned in the SDA model. Further research is needed to explore whether the extent of L2 cultural immersion has an impact on bilingual conceptual representation.

1.1.4 Self-Organizing Model

In recent years, self-organizing map (SOM) models have been used to simulate the emergence of both monolingual and bilingual lexical representations (Kiran, Grasemann, Sandberg, & Miikkulainen, 2013; Li, 2013; Li & Zhao, 2013, 2015; Zhao & Li, 2013). These are connectionist models with an unsupervised learning algorithm, in which learning occurs without explicit error signals to adjust the connection weights. The models can be used to map multi-dimensional data in a two-dimensional representation. The models consist of nodes on two-dimensional grids, with each node having connections to receive external stimuli that have multi-dimensional features. For instance, a SOM model can learn to represent colours on a two-dimensional map with each node receiving inputs with three-dimensional features such as RGB values. At the beginning, each node has a random weight, such that the activation of nodes is spread out on the map. When nodes become active in response to a stimulus, one node with the weight that closely matches the pattern of the input becomes the winner. The weight of the winning node and its neighbouring nodes are adjusted according to the physical proximity to the winning node, which makes them respond to the same or similar stimuli more strongly the next time the same input is encountered. Thus, as a map receives input from more stimuli, the activation pattern becomes more focused. Consequently, this self-organizing learning process results in a map with nodes that are activated by the input of similar features. This pattern of activity on the map is akin to the topographic maps in the sensory and motor areas in the brain (Zhao & Li, 2010), making the model biologically plausible. In applications to psycholinguistics, SOM models have been used to model various levels of representation including orthographic, phonological, and semantic representations (e.g., Ritter & Kohonen, 1989; Miikkulainen, 1997).

In addition to using a single SOM to represent one level of linguistic representation, a number of researchers have adopted a SOM-based model to create multi-layer neural networks that attempt to model the process of language acquisition (Miikkulainen, 1997; Li, Zhao, & MacWhinney, 2007; Li, 2003; Li, Farkas, & MacWhinney, 2004). For instance, DevLex-II (Li et al., 2007) is a multi-layer neural network model with separate layers of SOMs that learn to represent phonological and semantic lexical information. DevLex-II has three maps for the representation and organization of linguistic information: semantic, input phonology, and the articulatory sequence of output phonology. The semantic map has connections to the two other maps. The connections between maps are trained via the Hebbian rule. When the nodes on two maps are activated frequently and concurrently, their connections' weights become stronger. These cross-map connections enable one map to trigger the activation of nodes on another map. The performance of the model is evaluated based on how much the activation patterns match with correct word representations.

Adopting the SOM-based multi-layer neural network architecture, a few studies have investigated how bilingual lexical representations develop over time and the consequence of the timing at which inputs from two different languages are introduced. For example, Zhao and Li (2010) used DevLex-II to show how the structure of bilinguals' lexical representations for phonology and semantics changes depending on the onset time of their L2 learning. The model consisted of three levels of representation including input phonology, semantic, and output phonology. Semantic representations were generated based on a recurrent neural network that learned lexical co-occurrence constraints and word associations derived from the HowNet (Chinese) and WordNet (English) databases. This approach enabled the model to develop lexical representations based both on syntactic and semantic information, and to quantitatively represent semantic similarity between words within a language. The model was tested with three different scenarios: simultaneous, early, and late L2 acquisition. In simultaneous learning, both L1 and L2 lexicons were presented in a parallel manner. For the early learning scenario, L2 words were only presented to the network after being trained on 100 L1 words. In the late learning scenario, L2 words were presented after the network was trained on 400 L1 words. In the simultaneous condition, the network produced distinct lexical representations for L1 and L2 phonology and semantics such that L1 words tended to group together to form their own region on the map distinct from L2 words. On the other hand, the representations of L2 became more parasitic on L1 as the onset of L2 input was delayed, so that there were no clear regional boundaries on the map for L1 and L2 words. In other words, late L2 learning results in the lack of a distinct L2 lexical structure on the map.

Predictions can be derived from Zhao and Li's (2010) model regarding semantic accents. From the simulations just described, one might surmise that the degree to which bilinguals will display a semantic accent will depend on the onset time of their L2 learning. In the case of simultaneous learning, because the L1 and L2 words formed their own distinct regions in the map, those bilinguals should be unlikely to display a semantic accent. In contrast, bilinguals with later L2 acquisition have a parasitic representation of L2 words, suggesting that they are more likely to display semantic accents in their L2 because the activation of L2 representations would activate neighbouring L1 representations. This hypothesis seems inconsistent with the finding of semantic convergence in simultaneous bilinguals by Ameel et al. (2005) discussed earlier, where representations of both languages were mutually influenced by one another in such a way that the boundaries of each language were different from native speakers of either language.

Another study by Zhao and Li (2013) provided a mechanistic account for cross-language priming in Chinese-English bilinguals using the SOM-based model. Their model implementation successfully simulated previous empirical findings from cross-language priming experiments (Basnight-Brown & Altarriba, 2007; Dimitropoulou, Dunabeitia & Carreiras, 2011; Jiang, 1999; Jiang & Forster, 2001), including (1) the size of priming effects is larger for translation equivalents (e.g., 狗 – dog) than for semantically related words (e.g., 狗 – cat), (2) the size of priming effect is larger in the L1 to L2 direction than in the L2 to L1 direction (semantic priming asymmetry), and (3) the priming asymmetry is larger for late bilinguals than early bilinguals. Similar to Zhao and Li (2010), Zhao and Li (2013) used DevLex-II, which consisted of the same three basic maps (i.e., input phonology, semantic, and output phonology). Unlike Zhao and Li (2010), however, they added lateral connections within the semantic map to simulate cross-language interactions. Lateral connections have been used in other studies, such as the simulation of long-range connections between different areas in the primary visual cortex (Sirosh & Miikkulainen, 1994). Lateral connections play an important role in their model because their semantic map is based on the same databases as Zhao and Li (2010) (i.e., HowNet for Chinese and WordNet for English), which indicates that lexical items for each language would be represented in distinct regions especially for early bilinguals (as seen in Figure 2 in Zhao & Li, 2010). Thus, these lateral connections allow the model to simulate the connections between similar lexical items across languages (e.g., 狗 – dog, 狗 – cat), even though they may be represented spatially distant on the map.

The SOM model by Zhao and Li (2013) is likely to predict that bilinguals would exhibit semantic accents regardless of age of acquisition, because the lexical items in two languages are assumed to interact with each other via lateral connections. Furthermore, given that the model was able to simulate priming asymmetry for late bilinguals (i.e., priming effects are larger for the L1 to L2 direction than the L2 to L1 direction), it may also be able to predict that late bilinguals would exhibit stronger semantic accents in their L2 compared to early bilinguals because the influence of L1 on L2 would be stronger than L2 on L1. However, from their study, it is not clear whether their semantic representations contain enough detail to account for subtle conceptual differences between translation equivalent words. For example, one of the cross-language translation equivalent words used in their study was *spoon* and 勺子, but they do not necessarily refer to the same object (e.g., some Chinese spoons are made of ceramics and primarily used to eat soup). To account for such differences, it seems that physical or functional features that characterize the objects may better represent the semantic information compared to lexical co-occurrence constraints or word associations.

In a more recent study, Fang, Zinszer, Malt, and Li (2016) used a self-organizing connectionist network to model the phenomenon of semantic convergence shown in Ameel et al. (2005). In particular, the researchers simulated the object naming patterns of common household objects in Dutch-French simultaneous bilinguals. Although their model is also SOM-based, it differs from the one used in Zhao and Li (2010; 2013) in several respects. First, the model had an orthographic map in addition to semantic and phonological maps in order to explore whether orthographic similarity between Dutch and French influences naming patterns. Second, unlike the semantic representations that were used in previous versions of the model that were derived from separate databases for each language, the semantic representations used in this model were 68 physical and functional features (e.g., "it is made of glass") that were collected from 50 Dutch speakers by Ameel and colleagues. Such features allow representations on the semantic map to be shared between two languages, in contrast to the distinct semantic regions for each language seen in Zhao and Li's (2010) simulation of simultaneous language acquisition. Finally, they added lateral connections within the phonological map to simulate cross-language interaction of phonological word forms. These lateral connections allow object naming in one language to influence the other language. In their study, the researchers were particularly interested in finding out whether lateral connections (i.e., cross-language activations of word forms) and orthographic similarity play a role in simulating the bilingual object naming patterns observed in Ameel et al. (2005). To examine the influence of each of these components, they compared the standard model to impaired models without those components. The results revealed that their model could simulate the empirical results better with lateral connections than without lateral connections, while the inclusion of the orthographic map only had a modest influence. From these findings, the researchers suggested that the parallel activation of lexical forms in two languages is likely to be the contributing factor that causes semantic convergence in bilingual object naming patterns.

There are several implications of the Fang et al. (2016) study for research on bilingual conceptual representations. First, unlike Zhao and Li (2010; 2013), which used word co-occurrence databases for semantic representations, simulating bilingual object naming patterns seems to require a model to have semantic representations at a conceptual level (i.e., semantic features) that can be accessed by either language. Thus, their model simulation on bilingual object naming provides further support for the idea that bilingual conceptual representation can be better understood using a feature-based approach. However, their model simulation only involved simultaneous bilinguals whose languages are similar (i.e., Dutch and French), and how the SOM-based models would simulate semantic convergence in early or late bilinguals has not been investigated.

Therefore, more empirical feature-based studies in bilinguals with different language histories would contribute to further the development of bilingual computational models.

Secondly, while Fang et al. (2016) emphasized the importance of lateral connections within the phonological map, the researchers mentioned that all three models (including the impaired models that did not include such connections) captured semantic convergence in bilingual naming. More specifically, in the empirical study by Ameel et al. (2005), the correlation between Dutch and French naming patterns in bilinguals (0.88) was higher than the correlation of naming patterns in Dutch monolinguals and French monolinguals (0.63), suggesting semantic convergence in bilinguals. However, the correlation between Dutch and French naming patterns in bilinguals that were simulated in Fang et al. (2016) were relatively high in all of their three models, including the standard model (0.97), the model without orthography (0.95), and the model without lateral connections (0.80).

This finding indicates that their model might to be able to account for semantic convergence to some extent even without lateral connections. This seems to counter their argument that semantic convergence occurs due to parallel activation of lexical forms in two languages. One possible factor that may contribute to semantic convergence is the featural representation in the semantic map. Although the features were language-free, they were generated only by Dutch individuals. Recall from previous SOM-based models (Zhao & Li, 2010; 2013), the semantic representations were generated from databases for English and Chinese. Thus, it is not surprising that they produced distinct semantic regions for each language, and lateral connections were needed to simulate cross-language semantic priming. In Fang et al.'s simulation, however, such activation can occur without lateral connections, because similar semantic features should be represented close to each other. Thus, convergence between the Dutch and French conceptual representations might have occurred on the semantic map rather than the cross-language activation on the phonological map. However, since Fang et al. is the only study that employed semantic features in their model, more simulation with different language pairs or different L2 learning scenarios (i.e., early and late bilinguals) would provide further insights into the impact of the nature of semantic representation in SOM-based models.

1.2 Advantages of a Feature-Based Approach

There are several reasons why semantic features are ideal for studying bilinguals' conceptual representations. First, a growing body of monolingual research suggests that peoples' knowledge about concepts is represented as elements of information that are distributed across the brain in a modality-specific manner (Barsalou, 2008). That is, when people access the meaning of a word that is associated with an object, they activate information about how they perceive and interact with the object in the real world. For example, when we think of an apple, we access not only the visual information (e.g., round and red), but also the taste, how we eat it, and how it grows, and so on. Thus, in addition to perceptual or intrinsic features of objects and concepts, features such as functional, situational, or contextual features (e.g., "used for carving jack o'lanterns" for *pumpkin*) also play an important role in conceptual representations (Barsalou, Sloman, & Chaigneau, 2005). For example, a currently popular view referred to as grounded cognition (Barsalou, 1999) makes the assumption that similar neural circuits are activated in thinking about an object as when actually experiencing it. This view has been supported by both behavioural and neuroimaging studies (Goldberg, Perfetti, & Schneider, 2006; Hauk, Johnsrude, & Pulvermuller, 2004; Klatzky et al., 1989; Solomon & Barsalou, 2001; Zwann, Stanfield, & Yaxley, 2002).

Secondly, while differences in any type of conceptual knowledge can influence bilingual conceptual representations, the existing bilingual studies are primarily based on how bilinguals respond to visual images (Ameel et al., 2009; Jared et al., 2013; Malt, Li, Pavlenko, Zhu, & Ameel, 2015; Masuda et al., 2017; Pavlenko & Malt, 2011; Zhang, Morris, & Cheng 2013; Zinszer, Malt, Ameel, & Li, 2014). For example, a number of these studies employed a task where participants are shown a series of pictures and are asked to name or sort the objects. These studies have provided important evidence concerning the differences between bilinguals and monolinguals in their conceptual representations based on their lexical categorization patterns. However, some conceptual differences may not be reflected in patterns of naming objects that are depicted in visual images. For example, the typical use of balloons may be different depending on cultures (e.g., they are often used for birthday parties in North America, but not in Japan) but that does not influence how we name the object.

Features also provide a way to extract the part of conceptual representations that may differ across languages or cultural contexts. The challenge of studying subtle conceptual differences in translation equivalent words is to identify what the differences are, which depends on the concept. Features provide a way to represent such differences explicitly, making it easy to study how they are activated in bilinguals and monolinguals. Some concepts may be perceived differently because of the difference in visual features and others might look similar but may be used differently. Thus, if we know which semantic features are associated with a word in one language but not its translation equivalent, we would be able to seek a more fine-grained explanation of how bilinguals develop and activate conceptual information in their two languages.

Another strength of investigating bilinguals' conceptual knowledge in terms of features rather than as a whole is that it provides a way to explore the influence of feature type. For example, are certain types of L2 features easier to acquire than others? In the monolingual literature, there have been extensive studies on how the status of features influences concept or feature recognition (Ashcraft, 1978; Cree, McNorgan, & McRae, 2006; Forde & Humphreys, 1999; Solomon & Barsalou, 2001). For example, Nelson, Frankenfield, Morries, and Blair (2000) have shown that, whereas adults heavily rely on functional features over perceptual features when categorizing artifacts, children up to the age of four rely strongly on the appearance rather than functions of objects. This finding indicates that the type of feature is an important factor in understanding the development of conceptual knowledge about words and categories. Although there is not much evidence from the bilingual literature, Li, Zhang, and Wang (2011) have shown that that Chinese-English bilinguals have more difficulty accessing thematic relations (e.g., roof – house) compared to taxonomic relations (e.g., fruit – banana) in their L2 processing, whereas both thematic and taxonomic relations are readily processed in their L1. This finding suggests that certain types of L2-specific features may be more difficult to acquire than others. For example, bilinguals with little experience with their L2 may be able to learn explicit features (e.g., pumpkin – is orange) more easily that those that are more situation-based (e.g., pumpkin – used for carving jack o'lanterns).

1.3 Language Proficiency vs. Cultural Immersion

Bilingual language representation and processing are dynamic in nature and various factors may influence how bilingual conceptual representations develop (Hartanto & Suarez, 2015; Kroll & Stewart, 1994; Malt et al., 2015; Mok & Yu, 20017; Pavlenko, 2009; Pavlenko & Malt, 2011). Of these, many of the existing bilingual models, including the SDA model (Dong, et al., 2005), consider language proficiency as a key factor that impacts bilingual language processing (Dijkstra & van Heuven, 2002; Kroll & Stewart, 1994; Pavlenko, 2009).

As discussed earlier, the SDA model assumes that the nature of bilinguals' conceptual representations change depending on their L2 proficiency. This claim is supported by Dong et al. (2005), which shows that more proficient Chinese-English bilinguals have less of a semantic accent in their L2 and more of a semantic accent in their L1 than less proficient bilinguals. Furthermore, Hartanto and Suarez (2017) have shown that more L2 proficiency leads bilinguals to have more native-like conceptual representations for their L2. In their study, the researchers conducted a gender decision task (i.e., judge whether a given word refers to a male or female) in English with Indonesian-English bilinguals. The critical words all referred to a person of a specific gender in English (e.g., *nephew*, *king*), however, for half of the words, the Indonesian translation equivalents could be used for people of either gender, and for the other half the Indonesian translations referred to people of a specific gender. For example, the Indonesian translation of *nephew* is *keponakan*, which can be either male or female, but the Indonesian translation of "king" is raja, which refers to a male. The researchers found that the Indonesian-English bilinguals, but not English dominant bilinguals, responded more slowly when the gender is unspecified in the Indonesian (L1) translation compared to when the gender is specified in both languages. Furthermore, they found that this effect is smaller for proficient bilinguals than for less proficient bilinguals, suggesting that L2 processing in proficient bilinguals is less influenced by their L1 knowledge. These findings suggest that more L2 proficiency reduces semantic accents in L2.

On the other hand, there is an increasing interest in the effect of cultural immersion on bilingual conceptual representations, particularly for sequential adult bilingual speakers. For example, Malt and Sloman (2003) conducted a study in which non-native English speakers rated objects' typicality with respect to English labels. The researchers found that their rating patterns were more similar to native-English speakers as they spent more time in an English-speaking environment. Interestingly, their results indicated that years of cultural immersion was a better predictor of native-like ratings than years of formal English instruction. This finding implies that semantic accents can be reduced with greater L2 cultural experience rather than simply more linguistic knowledge. In another study, Pavlenko and Malt (2011) investigated how the age of arrival in the U.S (L2 speaking country) influences Russian-English bilinguals' performance on a naming task in their L1 (Russian). The bilinguals saw images of 60 drinking containers and their naming patterns were compared with their monolingual counterparts. The researchers found that the bilinguals' L1 naming pattern was strongly influenced by their L2 knowledge for those who arrived in the U.S at a young age. Furthermore, the influence of L2 was especially salient when the bilinguals had low L1 proficiency, suggesting that both early immersion in the L2 culture and low proficiency in L1 lead bilinguals to have semantic accents in their L1 object naming. More recently, Malt et al., (2015) found that even relatively late L2 cultural immersion influences bilinguals' lexical network in both L1 and L2. In their study, Mandarin-English bilinguals who immigrated to the U.S. no earlier than the age of 15 performed a naming task with common household objects. While their average length of residence in the U.S. was only two years, the researchers observed that their naming patterns in both L1 and L2 were different from those observed in corresponding monolinguals. This finding shows that the influence of one language on the other occurs in both L1-L2 and L2-L1 directions (i.e. semantic accents are observed in both languages) in late bilinguals, suggesting that bilinguals' conceptual representations remain plastic even after they develop a well-entrenched L1.

To summarize, these studies indicate that L2 cultural immersion seems to have a strong impact on bilingual conceptual representation, even in late bilinguals who have not necessarily spent a long period of time in the L2-speaking culture. The findings from previous studies suggest that both L2 proficiency and cultural immersion potentially predict the nature of bilingual semantic accents. Although there seems to be a strong impact of cultural immersion on bilingual conceptual representations, many of the existing bilingual models, including the SDA model, do not necessarily take this factor into account. By addressing the impact of both L2 proficiency and cultural exposure using a feature-based approach, the present research aims to better understand the developmental mechanisms of bilingual semantic accents.

1.4 The Present Research

The primary goal of my dissertation is to investigate how Japanese-English bilinguals represent and develop conceptual representations of translation equivalent words using a feature-based approach. Even though a pair of translation equivalent words (e.g., "pumpkin" and "kabocha") are considered to share roughly the same meaning, they often convey at least some conceptual information that is specific to a language or culture, which leads bilinguals to develop conceptual representations that are different from their monolingual counterparts (i.e., semantic accents). Although there are a few existing feature-based bilingual models, the evidence supporting these models is far from sufficient given that few empirical studies have systematically investigated whether semantic features can be used to represent language-specific conceptual knowledge.

My dissertation has two main objectives. The first is to explore whether conceptual differences in translation equivalent words can be empirically derived from feature production norms. This will be addressed in Chapter 2, where I discuss a study I conducted to compare semantic features for translation equivalent words collected from Japanese speakers residing in Japan and English speakers residing in Canada. This study provides an empirical way not just to collect potential language-specific features, but also to explore how the comparisons between feature production norms across language groups inform us regarding the conceptual differences in translation equivalent words, an issue that has barely been addressed in the current literature.

The second objective is to evaluate the predictions of the SDA model. While there are a few feature-based models that provide an account of bilingual conceptual representations, the SDA model (Dong, et al., 2005) has the most comprehensive and specific predictions that can be evaluated through empirical studies. In Chapter 3, I discuss three experiments I conducted on how Japanese-English bilinguals activate L1/L2 specific-features in their L1 and L2. This study provides insights into the development and reduction of semantic accents, as well as into whether there is asymmetry in their conceptual representations. The studies attempt to extend Dong et al. (2005) in several ways. First, I tested the predictions of the SDA model with different types of behavioural tasks: feature typicality rating (Experiment 1), feature verification (Experiment 2), and semantic priming with lexical decision (Experiment 3). The data from these tasks reveal whether semantic accents can be observed in both explicit and implicit judgment tasks. Second, the model predictions were tested with a greater number of language-specific features that were systematically identified, which provides a stronger evaluation of the predictions of the model than was provided in Dong et al. Third, I collected data from Japanese-English bilinguals who not only differed in their L2 proficiency, but also in their degree of L2 cultural exposure. This allowed me to investigate whether L2 cultural immersion has a significant impact on the development of semantic accents. Fourth, different types of features (perceptual and situational) were included in the studies to explore whether visually explicit features (e.g., pumpkin – is orange) are learned more easily compared to less explicit situational features (e.g., pumpkin – used for carving jack o'lanterns) or vice versa.

To summarize, this study aims to uncover the organization of bilingual conceptual representations of L1 and L2 words, as well as the influence of different factors on the development of such representations. While the current research focused on testing the predictions of the SDA, more empirical data with a feature-based approach will provide data that is relevant to other bilingual models as well.

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2 A Comparison of Japanese and English Feature Norms Using Translation Equivalent Words

2.1 Introduction

Semantic memory is a type of long-term memory that involves knowledge of facts about the world. It plays an essential role in our ability to understand concepts and language, and has been one of the critical research fields in cognitive science. The growing body of recent literature on semantic memory claims that our conceptual knowledge is represented in terms of a collection of semantic features that are distributed in a modality-specific manner (McRae & Jones, 2013). According to this view, a concept (e.g., dog) is represented in terms of semantic properties (e.g., has 4 legs, has a tail, chases, barks), which are organized based on the types of sensory experience, such as visual and auditory information.

Many models of semantic memory have used feature norms (e.g., Cree, McNorgan, & McRae, 2006; Cree & McRae, 2003; McRae, de Sa, & Seidenberg, 1997; Garrard, Lambon Ralph, Hodges, & Patterson, 2001; Rogers & McClelland, 2004), in which participants are given a set of words that denote concepts and are asked to describe the features such as how they look or how they are used. Since not all features can be verbalized or are necessarily produced by participants (e.g., people rarely list the feature <breathes> for the concept “dog” even if it is true), they are not considered to reflect the exact conceptual representations stored in the brain (McRae, Cree, Seidenberg, & McNorgan, 2005). Nonetheless, there is a broad consensus in the current literature that people interpret a concept by simulating its properties (Barsalou, 2003; Vivas, Vivas, Comesana, Coni, & Vorano, 2017), making feature norms a useful tool to investigate the people’s conceptual knowledge.

Feature norms have been a valuable resource both as qualitative and quantitative measures of conceptual representation (Vivas et al., 2017). For example, they have been used to measure semantic similarity between concepts or how different types of knowledge are distributed across concepts (Montefinese, Ambrosini, Fairfield, & Mommarella, 2012; Montefinese, Zannino, & Ambrosini, 2015; Vigliocco, Vinson, Damian, & Levelt, 2002; Vigliocco et al., 2004). Furthermore, they have been also used to study deficits in semantic memory. In Cree and McRae (2003), the researchers employed feature norms to demonstrate that in patients with category-specific semantic deficits, the loss of the ability to distinguish different categories of concepts not only arises from impairment in particular types of knowledge (e.g., visual, motor, etc.), but is also affected by variables such as feature informativeness, visual complexity, and name frequency.

Although feature norms have been commonly used to study conceptual organization, a number of studies have pointed out the lack of feature norms that are publicly available (Kremer & Baroni, 2011; McRae et al., 2005; Vivas et al., 2017). Currently, the number of semantic feature databases is gradually increasing but most of them are in English (Devereux, Tyler, Geertzen, & Randall, 2014; Grarrard et al. 2001; McRae et al., 2005; Vinson & Vigliocco, 2008). There are several norms in Indo-European languages (English, Dutch, German, Italian, and Spanish) (De Deyne et al., 2008; Kremer & Baroni, 2011; Lenci et al., 2013; Montefinese et al., 2012; Ruts et al., 2004; Vivas et al., 2017) but there are no semantic feature norms available for any Asian language.

Feature norms in different languages allow researchers to explore whether people who use a certain language possess somewhat different knowledge for a given concept compared to those who use another language. For example, while *kettle* is translated in Japanese as やかん, Canadian English speakers may think of an electric kettle while Japanese speakers may think of a round-shaped stovetop kettle (see Figure 2.1).

Figure 2. 1. Typical images of "kettle" (left) and "やかん" (right), which are considered as translation equivalent words.

In fact, it is well-known that translation equivalent words do not necessarily refer to the same semantic information (De Groot, 2011) and a substantial amount of recent literature suggests that both language and cultural contexts influence people's conceptual knowledge of a word (Athanasopoulos, 2015; Lupyan & Lewis, 2017; Masuda, Ishii, Miwa, Rashid, Lee, & Mahdi, 2017; Paivio, 2007; Pavlenko, 2009). While features production norms seem to be useful to identify such conceptual differences between translation equivalent words, few studies to date have attempted to compare feature norms in different languages.

In order to explore whether any difference arise due to linguistic factors, Kremer and Baroni (2011) compared feature norms collected from German and Italian speakers. These speakers were recruited in Bolzano (Italy), a region where two groups of native speakers, German and Italian, reside together. Thus, although these two groups of participants spoke different languages, they shared cultural experiences. While researchers reported a few differences (e.g., features that denote taxonomic information were more frequent in Italian than German), they concluded that there was no remarkable difference between the two feature norms. On the other hand, an unpublished study by Tanabe-Ishibashi, Ishibashi, and Saito (2014) compared feature norms produced by English speakers and Japanese speakers, who differ both in their languages and cultures. Here, the researchers claimed that speakers of one language are more likely to attend to certain aspects of knowledge than speakers of another, given that the proportion of functional feature production frequency given by Japanese speakers was significantly higher compared to English speakers. In another study, Lenci et al. (2013) collected norms from two groups of Italian speakers, who were either sighted or blind. They reported that blind participants listed fewer features that denote perceptual properties compared to sighted participants. Given that blind people are limited in perceptual ability, the result may not be so surprising. However, the study provides important empirical evidence indicating that people's conceptual knowledge is influenced by their physical environments. Additionally, Vivas et al. (2017) suggested that differences may be observed in individual features. For example, they reported that the feature <tango> was produced frequently for the concept *accordion* in their Spanish feature norms whereas it was not present in the English feature norms by McRae et al. (2005). On the other hand, the feature <polka> was listed frequently in the English norms but not in the

Spanish norms. Such differences may be observed more frequently when the two languages are used in different cultural contexts.

The present study has two main objectives. The first objective is to collect semantic feature norms for 80 translation equivalent words from Canadian English speakers and Japanese speakers, who are comparable in terms of age and education level (e.g., university students) but differ in their languages and cultures. The second objective is to systematically compare the English and Japanese feature norms to explore what differences may be observed. Such comparisons have been largely overlooked in the existing feature norming literature (Kremer & Baroni, 2011). Since the English and Japanese languages are very different from each other, Japanese features were not translated into English in order to avoid the risk of distorting the original meanings conveyed in Japanese. In the present study, I analysed the frequency distributions of different feature types (e.g., visual colour, function, location, etc.) to investigate whether the native speakers of one language attend to certain types of information more than those who speak the other language. More critically for subsequent experiments, further observations were made at the individual feature level in order to identify features that that arise specifically in one language.

2.2 Method

2.2.1 Participants

The total number of participants was 431, consisting of 218 English speakers who were born and living in Canada (male = 107, mean age = 18.5 years, *SD* = 1.78) and 213 Japanese speakers who were born and living in Japan (male = 81, mean age = 20.2 years, *SD* = 1.26). English speakers were undergraduate students who were recruited at Western University (Ontario, Canada) and Japanese speakers were undergraduate students who were recruited at Waseda University (Tokyo, Japan). Both groups of participants had their respective target language (English or Japanese) as their native language. All participants received a course credit for their participation.

2.2.2 Stimuli

Eighty pairs of translation equivalent words were used (see Appendix A). All items were words that denote concrete concepts, and consisted of 63 non-living and 17 living things (21 natural and 59 man-made objects). The items were common words used in everyday life (e.g., kettle, fish, broom) to maximize the likelihood that they would be familiar to all participants. These words were selected with the expectation that differences between English and Japanese feature norms would be observed, which was based on my intuition. For example, Japanese speakers were expected to be more likely to come up with the feature "is green" for the word *pumpkin* (Japanese translation: かぼちゃ /kabocha/), because pumpkins in Japan typically have green skin.

2.2.3 Procedure

The 80 words were divided into 10 lists and each participant received one of the lists that consisted of eight words. The participants were asked to list up to 10 features for each word. The data from English speakers were collected using Qualtrics and those from Japanese speakers were collected using a paper-based questionnaire (due to an administrative reason). Each concept was presented with 10 blank lines on paper (for Japanese speakers) or 10 blank boxes on a computer screen (for English speakers). Care was taken to avoid including semantically similar words (e.g., fish and guppy) on the same list. On average, each word received responses from 21.1 English speakers (SD = 2.5) and 21.3 Japanese speakers (SD = 1.8). The task took approximately 30 minutes to complete.

2.2.4 Recording and Labelling

All features produced by participants were digitally transcribed. Because the production task involved free generation of features by a large number of participants, their responses varied due to minor differences (e.g., letter cases, synonyms, omitting articles). For example, different entries that essentially convey the same information (e.g., "has 4 legs" vs. "has four legs") need to be recoded identically so that they could be counted as the same feature. To make such adjustments, I first used the R package to remove minor differences that were common in the norms. This approach was helpful to keep track of what adjustments were made and to avoid potential errors made by hand.

The adjustments made for the English feature norm are as follows: (1) all features were coded with lowercase letters, (2) habitual words (i.e., usually, always, often, sometimes, very, actually, almost, every) were removed, (3) numbers in words were changed to numerals (e.g., "two" to "2"), (4) articles were removed (i.e., "a", "an", "the"), (5) beginning phrases that carry little distinctive meaning were removed (i.e., is, are, it's, it is, it, they, they are, may be, may, maybe, can be, can) were removed, and (6) "have" was changed to "has". The adjustments made for the Japanese features were as follows: (1) habitual words were removed; i.e., だいたい(usually), 大体(usually), 良く(often), よく(often), たいてい(usually), たまに(sometimes), ときどき(sometimes), 時々(sometimes), とても(very), (2) instances of the expression "である" (equivalent to "is" in English) at the end of descriptions was removed because this expression conveys little distinctive meaning. The number of adjustments made for Japanese norms were fewer than English norms because of the differences in linguistic characteristics. In Japanese, one can use three different scripts to denote the same concept (e.g., DOG can be written using Kanji script [犬], hiragana script [いぬ], and katakana scripts [イヌ]). These differences in scripts are difficult to adjust automatically, since there are many homophones and the pronunciation of kanji scripts change depending on the context. In addition, unlike English, there are no spaces between words (e.g., "has 4 legs" in Japanese would be a phrase without any space between words "足が４本ある". For these reasons, most adjustments made to reduce feature variability were done manually. For both English and Japanese norms, synonyms were identified manually.

The Japanese norms were not translated into English because of the difficulty of translating the descriptions without distorting the meanings, which may be conveyed in the original descriptions.

Feature types were labelled based on Cree and McRae's (2003) Brain Region Taxonomy, which was developed in order to link different features to different brain areas. In this taxonomy, features are classified into nine types of knowledge, including visual information (*visual colour, visual form and surface, visual motion*), other primary sensory information (*smell, sound, touch, and taste*), functional/motor information (*function*), and all other knowledge types (*encyclopaedic*). This classification is particularly attractive because it is consistent with the idea in the current literature that semantic knowledge is organized in a modality-specific manner. For the purpose of the current research, encyclopaedic features were further divided into four sub-categories: emotion, location, time, and others, since the frequency of those aspects of information may particularly be influence by cultural circumstances. For example, the concept *balloon* may elicit a feature “used at birthday parties” (time) for Canadian English speakers but not for Japanese speakers, since balloons are often used for the decoration at birthday parties in Canada. On the other hand, the concept *air conditioner* may elicit “found on walls” (location) for Japanese speakers but not Canadian English speakers, since it is common to install air conditioners on walls in Japan. Thus, the features collected in the current study were classified into 13 types of knowledge. The examples of features for each knowledge type are listed in Appendix B. The production data are presented in the excel file, which can be accessed at https://www.dropbox.com/s/7jh8gr3stw1fwww/FeatureNorms_English%26Japanese.xlsx?dl=0. The descriptions of variables included in the production file are listed in Appendix C.

2.3 Results and Discussion

2.3.1 Descriptive Data

In total, 14,092 properties were collected from English speakers and 12,229 properties were collected from Japanese speakers. The average number of properties obtained per participant for a word was 8.08 (*SD* = 2.30) for English speakers and 7.18 (*SD* = 1.89) for Japanese speakers. Prior to further analyses, any word-feature pairs that were produced by only one participant were considered as a rare occurring feature and excluded from the norms. In addition, responses for the word "subway" were excluded from all data because there was ambiguity in meaning among English-speaking participants (some participants interpreted it as an underground railroad while others interpreted it as a sandwich chain restaurant). The examples of listed features and their frequencies for a given word can be found in Appendix C (English) and D (Japanese).

As a result, 9,658 English properties (68.5% of the original data) and 7,638 Japanese properties (62.5% of the original data) were retained for further analyses. If I do not count the same word-feature pairs across participants, these properties consisted of 2221 distinct English word-feature pairs and 1879 distinct Japanese word-feature pairs. For example, if there are 10 people who produced the feature "is yellow" for the word *bus*, the feature production frequency is 10 but the number of distinct word-feature pairs is counted as one. If the feature "is yellow" is listed for the word *bus* by 10 people and for the word *taxi* by 15 people, they are counted as two distinct word-feature pairs. The mean number of distinct features per word was 28.2 (*SD* = 4.75) for English speakers and 24.1 (*SD* = 4.47) for Japanese speakers. The distribution of production frequency and distinct word-feature frequency are summarized in Table 2.1.

Table 2. 1. The Distribution of Feature Production Frequency and Unique Word-Feature Frequency

	English		Japanese	
	Production Frequency	Distinct Word-Feature Pairs	Production Frequency	Distinct Word-Feature Pairs
Emotion	159 (1.6%)	37 (1.7%)	120 (1.6%)	24 (1.3%)
Encyclopaedic	1888 (19.5%)	534 (24.0%)	1663 (21.8%)	515 (27.4%)
Function	1933 (20.0%)	438 (19.7%)	1200 (15.7%)	304 (16.2%)
Location	698 (7.2%)	173 (7.8%)	500 (6.5%)	145 (7.7%)
Smell	42 (0.4%)	16 (0.7%)	30 (0.4%)	10 (0.5%)
Sound	205 (2.1%)	41 (1.8%)	120 (1.4%)	32 (1.7%)
Taste	154 (1.6%)	29 (1.3%)	233 (3.1%)	33 (1.8%)
Taxonomic	612 (6.3%)	121 (5.4%)	489 (6.4%)	106 (5.6%)
Time	229 (2.4%)	51 (2.3%)	221 (2.9%)	51 (2.7%)
Touch	427 (4.4%)	95 (4.3%)	439 (5.7%)	93 (4.9%)
Visual colour	541 (5.6%)	104 (4.7%)	598 (7.8%)	108 (5.7%)
Visual Form and Surface	2401 (24.9%)	522 (23.5%)	1662 (21.8%)	388 (20.6%)
Visual motion	369 (3.8%)	60 (2.7%)	363 (4.8%)	70 (3.7%)
Total	9658	2221	7638	1879

2.3.2 Comparisons of the Feature Frequency Distributions

First, the overall frequency distribution seems similar across languages (e.g., the frequency of Encyclopaedic, Functional, and Visual Form and Surface features are quite high in both English and Japanese norms). One of the potential differences between the English and Japanese norms is that speakers of one language may attend to a certain knowledge type (e.g., function, visual colour) more than those speaking the other language. The current study explored this issue by comparing the production frequency distribution of different knowledge types. A Chi-square test of independence was conducted to compare the frequency distributions of different feature types between the English and Japanese feature norms. The analysis revealed that the distribution of feature type frequency differed significantly between the two norms, χ^2 (12) = 182.22, p < .001. To further analyze where these differences arise, I employed the post-hoc analysis described by Sharpe (2015). This analysis examined the standardized residuals from the comparison between English and Japanese norms for the pattern of feature distribution. In Table 2.2, the raw residuals (R. Res) indicate the differences between the expected and observed frequencies within each cell of the table. Since the raw residuals become larger with the size of expected frequency values, the standardized residuals (Std. Res) were calculated for the test of independence. Raw residuals were calculated by subtracting expected frequency from observed frequency (e.g., the raw residual for English emotional feature was calculated by subtracting 155.8 from 159). Standard residuals were calculated by dividing raw residuals (e.g., 3.2) by the square root of expected values ($\sqrt{155.8}$), which varies between English and Japanese norms. Thus, standardized residuals differ between English and Japanese while the raw residuals have the same absolute values between the two norms. Higher standardized residuals indicate that they contribute more to the Chi-square value. Significant differences were reported following the convention presented by Agresti (2007): standardized residuals with an absolute value that exceeds 2, which reflects an approximate .05 significance level. For Function features and Visual Form and Surface features, English speakers produced more while Japanese speakers less than the expected values. On the other hand, Japanese speakers produced more Encyclopaedic, Taste, Touch, and Visual Colour features compared to the expected values while English speakers produced less. The frequency distribution of different feature types is presented in the mosaic plot (See Figure 2.1), created using the vcd package in R (Meyer, Zeileis, & Hornik, 2006).

The current results indicate that the proportion of different types of features for the words differ between English speakers and Japanese speakers. Given that the existing feature norm comparison between German and Italian (Kremer & Baroni, 2011) found no considerable difference, the findings from the comparison between English and Japanese feature norms may imply that we can expect greater differences in feature norms when the two groups of participants differ in both language and culture. However, because the words used in the current study (which consisted of 21 natural objects and 59 man-made objects) do not correspond to those used in Kremer and Baroni (which consisted of 25 natural objects and 25 man-made objects), it may also be the case that the type of word referent influences what type of features are more likely to be produced by speakers in different languages. For example, Japanese speakers may be more likely to produce functional features for natural objects than English speakers. Tanabe-Ishibashi, et al. (2014) collected features for 64 words that denote concepts (32 natural and 32 man-made objects) from Japanese speakers and claimed that the proportion of functional features in their Japanese norms was higher than in the comparable English feature norms collected by Garrard, et al. 2001). On the other hand, in the current study, I found that the proportion of functional features was lower in the Japanese norms (15.7%) compared to the English norms (20%). Therefore, the production frequency of different feature types may be sensitive to the class of concepts.

Table 2. 2. Feature Frequency Distribution (Expected Frequency in Brackets) with Raw and Standardized Residuals

	English			Japanese		
	Feature Frequency	R. Res	Std. Res	Feature Frequency	R. Res	Std. Res
Emotion	159 (155.8)	3.2	0.26	120 (123.2)	-3.2	-0.29
Encyclopaedic	1888 (1982.9)	-94.9	-2.13*	1663 (1568.1)	94.9	2.40*
Function	1933 (1749.5)	183.5	4.39*	1200 (1383.5)	-183.5	-4.93*
Location	698 (669.0)	29	1.12	500 (529.0)	-29	-1.26
Smell	42 (40.2)	1.8	0.28	30 (31.8)	-1.8	-0.32
Sound	205 (181.5)	23.5	1.75	120 (143.5)	-23.5	-1.96
Taste	154 (216.1)	-62.1	-4.22*	233 (170.9)	62.1	4.75*
Taxonomic	612 (614.8)	-2.8	-0.11	489 (486.2)	2.8	0.13
Time	229 (251.3)	-22.3	-1.40	221 (198.7)	22.3	1.58
Touch	427 (483.6)	-56.6	-2.57*	439 (382.4)	56.6	2.89*
Visual colour	541 (636.0)	-95	-3.77*	598 (503.0)	95	4.24*
Visual Form and Surface	2401 (2268.8)	132.2	2.78*	1662 (1794.2)	-132.2	-3.12*
Visual motion	369 (408.7)	-39.7	-1.97	363 (323.3)	39.7	2.21*
Total	9658			7638		

Note: * indicates $p < .05$

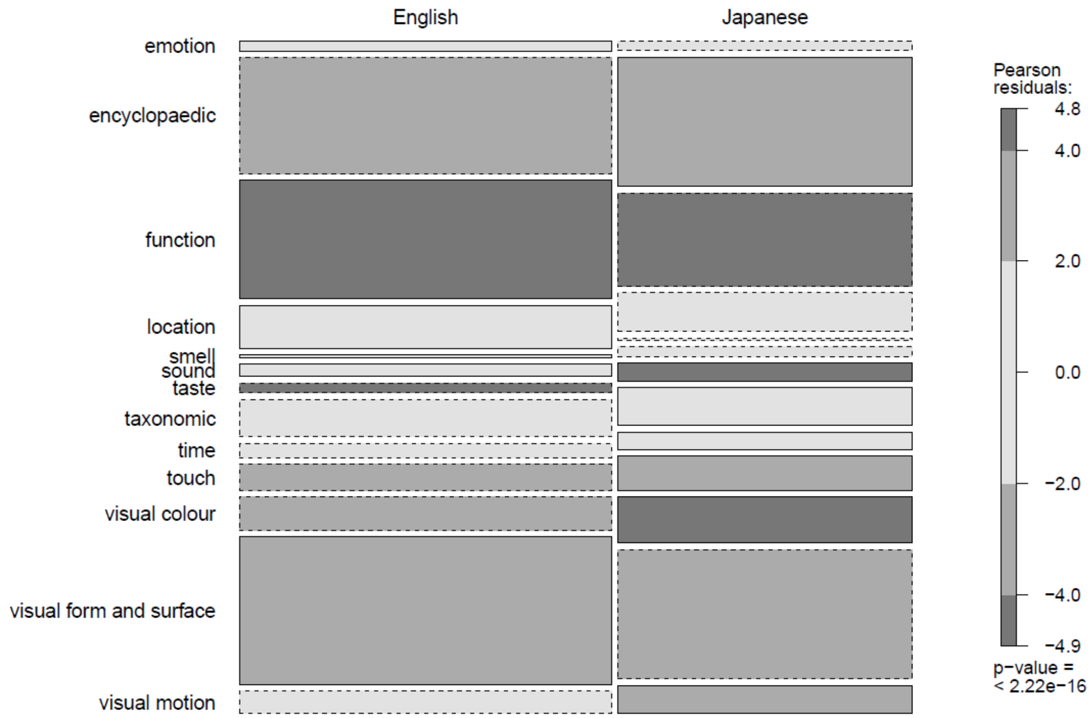

Figure 2. 2. The proportion of the frequency distribution attributable to each of the 13 feature types in the English and Japanese norms (box height). Boxes with solid lines indicate a greater proportion compared to those in the other language.

2.3.3 Comparisons of the Frequency Distribution of Distinct Word-Feature Pairs

Another question that I addressed was whether the distribution of the number of distinct word-feature pairs differs across languages. A Chi-square test of independence was conducted to compare the frequency distributions of distinct word-feature pairs between English and Japanese feature norms. The analysis revealed that the distribution of feature type frequency differed significantly between the two norms, χ^2 (12) = 25.78, $p < .05$. Using the same post-hoc analysis described above, the standardized residuals for each cell were calculated (See Table 2.3). The mosaic plot in Figure 2.2 represents the frequency distribution of different feature types. While Japanese speakers produced more Encyclopaedic features and less function features compared to English speakers, the standardized residuals did not reach significance. Hence, there were no substantial differences between the two norms in terms of the variations of unique word-feature pairs.

Table 2. 3. Frequency Distributions of Distinct Word-Feature Pairs (Expected Frequency in Brackets) with Raw and Standardized Residuals

	English			Japanese		
	Distinct Word-Feature Pairs	Res	Std. Res	Distinct Word-Feature Pairs	Res	Std. Res
Emotion	37 (33.0)	4	0.69	24 (28)	-4	-0.75
Encyclopaedic	534 (568.3)	-34.3	-1.44	515 (480.8)	34.2	1.56
Function	438 (401.9)	36.1	1.80	304 (340.1)	-36.1	-1.96
Location	173 (172.3)	0.7	0.06	145 (145.7)	-0.7	-0.06
Smell	16 (14.1)	1.9	0.51	10 (11.9)	-1.9	-0.55
Sound	41 (39.5)	1.5	0.23	32 (33.5)	-1.5	-0.25
Taste	29 (33.6)	-4.6	-0.79	33 (28.4)	4.6	0.86
Taxonomic	121 (123)	-2	-0.18	106 (104)	2	0.19
Time	51 (55.3)	-4.3	-0.57	51 (46.7)	4.3	0.62
Tactile	95 (101.8)	-6.8	-0.68	93 (86.2)	6.8	0.74
Visual colour	104 (114.8)	-10.8	-1.01	108 (97.2)	10.8	1.10
Visual Form and Surface	522 (493)	29	1.31	388 (417)	-29	-1.42
Visual motion	60 (70.4)	-10.4	-1.24	70 (59.6)	10.4	1.35
Total	2221			1879		

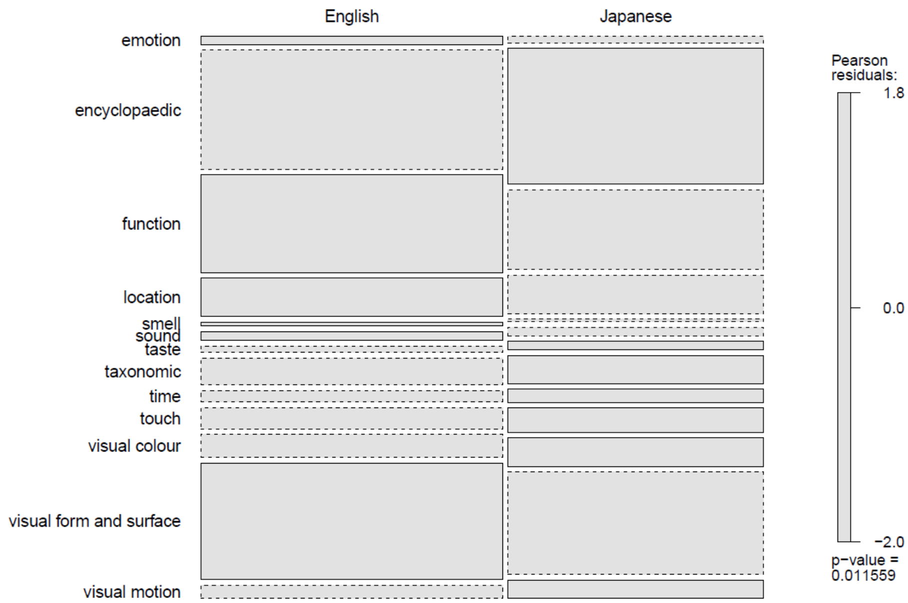

Figure 2. 3. The proportion of the frequency distribution of unique word-feature pairs attributable to each of the 13 feature types in the English and Japanese norms (box height). Boxes with solid lines indicate a greater proportion compared to those in the other language.

2.3.4 Language-Specific Features

There are a number of features that were listed in the norms in one language but not in the other. To explore how many language-specific features can be found, I identified frequent word-feature pairs listed in the norms in one language (i.e., listed by five or more participants) and manually inspected the norms in the other language to find out if the same or similar feature was produced by any speakers of that language. For example, the feature <used to play music> for the word *piano* was considered as a feature that is common in both languages because 10 English speakers produced the feature and three Japanese speakers produced the feature <音楽を奏でる>, which can be translated as "plays music". On the other hand, the feature <緑> (means "green" in Japanese) for the word *public phone* was considered as a Japanese-specific feature because it was produced by 18 Japanese speakers while no English speakers produced the feature <green>. Examples of language-specific features are listed in Appendix E. The number of these language-specific word-feature pairs was counted regardless of their production frequency. In total, 217 English-specific (accounts for 1,576 features produced by

English speakers) and 153 Japanese-specific (accounts for 1,089 features produced by Japanese speakers) word-feature pairs were identified. In order to compare the distribution frequency of unique word-feature pairs between the English and Japanese norms, a Chi-square test of independence was conducted. The analysis revealed that the distribution of feature type frequency differed significantly between the two norms, χ^2 (12) = 25.78, $p < .05$. This analysis indicates that the number of unique language-specific features in certain feature types was greater than expected. The standardized residuals for each cell were calculated (See Table 2.4). As seen in Figure 2.3, post-hoc analysis revealed that Japanese speakers produced more language-specific features that denote visual colour than expected, but there were no other significant differences.

Further inspection revealed that although some features were only produced in the norms in one of the languages, that feature was not necessarily absent from the referent in the other culture. For example, a feature “has seats” for the word *bus* was listed by Japanese but not Canadian English speakers, suggesting that there may be common features that are more or less likely to be produced depending on language or culture. Other word-feature pairs appear to be unique in a certain language or culture. For example, “used for birthday” was listed for *balloon* by English Canadian participants. However, it was not listed by Japanese participants, possibly because it is not common to use balloons as birthday party decorations in Japan. In some cases, the notion of a feature itself seems to be language-specific. For example, Japanese speakers listed a feature “used for noh” for the word *mask*. Noh refers to a form of Japanese traditional musical performance, which would be much less known to most people in North America. Thus, not only is the feature atypical for a word, the meanings of the feature may not even be recognized by the speakers of the other language.

Table 2. 4. Frequency Distributions of Language-Specific Word-Feature Pairs (Expected Frequency in Brackets) with Raw and Standardized Residuals

	English			Japanese		
	Frequency	Res	Std. Res	Frequency	Res	Std. Res
Emotion	3 (2.3)	0.7	0.46	1 (1.7)	-0.7	-0.54
Encyclopaedic	40 (49.3)	-9.3	-1.32	44 (34.7)	9.3	1.58
Function	46 (39.3)	6.7	1.07	21 (27.7)	-6.7	-1.27
Location	22 (18.2)	3.8	0.89	9 (12.8)	-3.8	-1.06
Smell	1 (0.6)	0.4	0.52	0 (0.4)	-0.4	-0.63
Sound	4 (2.3)	1.7	1.12	0 (1.7)	-1.7	-1.30
Taste	2 (5.9)	-3.9	-1.61	8 (4.1)	3.9	1.93
Taxonomic	9 (9.4)	-0.4	-0.13	7 (6.6)	0.4	0.16
Time	11 (10.6)	0.4	0.12	7 (7.4)	-0.4	-0.15
Touch	6 (7.6)	-1.6	-0.58	7 (5.4)	1.6	0.69
Visual colour	9 (17.0)	-8	-1.94	20 (12.0)	8	2.31*
Visual Form and Surface	54 (44.6)	9.4	1.41	22 (31.4)	-9.4	-1.68
Visual motion	10 (10.0)	0	0	7 (7.0)	0	0
Total	217			153		

Note: * indicates $p < .05$

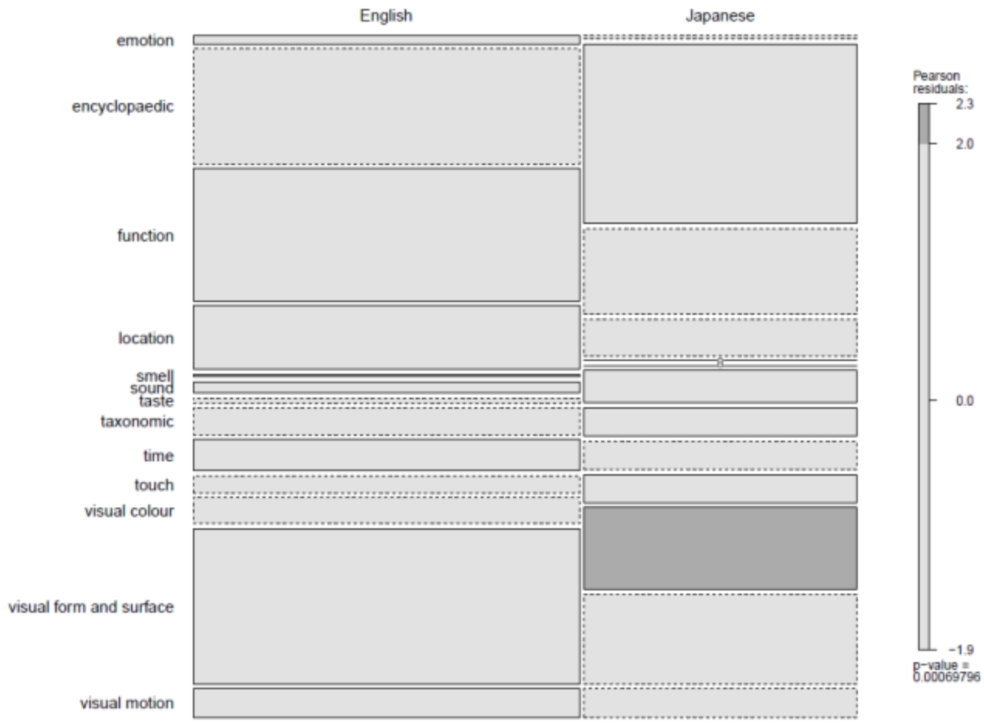

Figure 2. 4. The proportion of the frequency distribution for language-specific features attributable to each of the 13 feature types in the English and Japanese norms (box height). Boxes with solid lines indicate a greater proportion compared to those in the other language.

2.4 Summary

The present study identified several differences between English and Japanese feature norms. First, the distribution of feature types that were used to describe word that denote concepts varied between English and Japanese. While similar cross-language comparisons of features norms were previously conducted in German and Italian (Kremer & Baroni, 2011), the current findings provide additional evidence that more differences may be observed between speakers of different languages, especially when they belong to different cultures. In addition, the nature of the differences in feature distribution can also depend on the choice of concepts. While Tanabe-Ishibashi, et al. (2014) reported that the difference between English and Japanese feature norms in distribution frequency was only found for functional features, the comparison in the present study resulted in differences in several feature types of features (e.g., function, visual colour, taste).

Furthermore, language-specific features were observed in the current study (e.g., "green" for pumpkin was produced frequently by Japanese speakers but no English speakers produced the particular feature). As discussed in Vivas et al. (2017), linguistic and cultural factors are likely to influence what features may be produced by participants. This study has demonstrated that feature norms can be used to identify features that are not common to translation equivalent words, and that they therefore provide a useful way to identify the conceptual differences between translation equivalent words.

Finally, the present study provides feature production norms for an Asian language, which is not currently available in the literature. The norms can be used not only to study the conceptual representations of monolinguals, but can also be used to study the conceptual representations of Japanese-English bilinguals, which will be addressed in Chapter 3.

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3 Semantic Accents in Bilinguals

3.1 Introduction

To recap from Chapter 1, research on bilingual conceptual representations has suggested that bilinguals activate somewhat different meanings for words than their monolingual counterparts due to their knowledge of the other language (Ameel, Storms, Malt, & Sloman 2005; Degani, Prior, & Tokowicz, 2011; Dong, Gui, & MacWhinny, 2005; Hartanto & Suarez, 2016; Jared, Poh, & Paivio, 2013; Malt, Li, Pavlenko, Zhu, & Ameel, 2015; Malt & Sloman 2003). Such a phenomenon arises from the fact that translation equivalent words do not necessarily convey the same conceptual information, and because knowledge of one language can influence the comprehension and production of the other language. As noted in that chapter, De Groot (2014) refers to the deviation of bilinguals from monolinguals in their activation and use of word meanings as a "semantic accent". Semantic accents may occur in both the first and second languages of bilinguals. For example, Ameel et al. (2005) found that bilinguals named objects in such way that their lexical categorization patterns in L1 and L2 were more similar than those observed in monolinguals of the two corresponding languages. The researchers suggested that such semantic convergence seen in bilinguals would result from language-specific conceptual features either being dropped or being integrated into the other language.

In Chapter 1 I argued that a fruitful way of investigating lexical conceptual representations in bilinguals in more detail is to take a semantic feature approach and to focus in particular on language-specific semantic features. As was noted, the use of semantic features is common in many theories of conceptual knowledge (Collins & Quillian, 1969; Jackendoff, 1990, 2002; Minsky, 1975; Norman & Rumelhart, 1975; Saffran & Sholl, 1999; Smith & Medin, 1981; Caramazza & Shelton, 1998; Farah & McClelland, 1991; Humphreys & Forde, 2001) and the idea has been adopted in some bilingual models, including the Distributed Conceptual Feature (DCF) model (Van Hell & De Groot, 1998) and the Shared (Distributed) Asymmetrical (SDA) model (Dong et al., 2005). A key assumption of these feature-based bilingual models is that the conceptual differences in translation equivalent words can be described in terms of language-specific features. Semantic accents in bilinguals can be considered to emerge from the activation of language-specific features when they are using the other language.

For example, the word *pear* is translated into *nashi* in Japanese. Because a *nashi* in Japan is typically round, Japanese-English bilinguals may exhibit a semantic accent by activating the information "is round" when they process the English word *pear*. Current evidence for semantic accents is mostly based on object naming studies (Degani et al., 2011; Jared et al., 2013; Malt et al., 2015; Malt & Sloman 2003; Ameel et al., 2005). However, subtle conceptual differences may not always be reflected in different patterns of naming. Tasks that tap into semantic features specifically can be useful tools to investigate the nature of semantic accents that cannot be observed in lexical categorization.

In Dong et al. (2005), the researchers investigated the connection strength between concepts and features by asking participants to perform a similarity ranking task. In this task, they were given 16 sets of words that each consisted of one head word (e.g., *red*) and eight other words (e.g., *bride, debt, color, future*, etc) and ranked the meaning closeness of the eight words to the head words. The mean rankings of each combination of the eight words and the head word were calculated and the ranking patterns of each group of participants were compared to each other. Given that the number of stimuli was small in their study, this approach seems to be a good way to assess the similarity of the lexical conceptual representations among different groups of bilingual and monolingual participants. However, a more direct and simple way to assess the word-feature connection strength would be to ask the participants to rate the degrees of feature typicality for a given concept. Furthermore, the present study also conducted feature verification and semantic priming lexical decision tasks to explore whether bilinguals perform differently when the task is timed or implicit in nature. In particular, priming effects between concepts and language-specific features would provide stronger evidence that semantic accents reflect differences from monolinguals in conceptual representations, given the task does not require participants to consciously seek the relationship between concepts and features.

One challenge in testing a feature-based bilingual model is the difficulty in identifying language-specific features. A part of the reason for this difficulty may be that there has not been a systematic way to identify those features. The present study focuses on Japanese-English bilinguals and takes advantage of the feature production norms collected in the study described in Chapter 2. The comparison of English and Japanese norms demonstrated that language-specific features can be empirically derived from a feature production task. This work significantly contributed to the identification of stimuli for the current study. However, the current study required an even larger number of word-feature pairs, with no repetition of features. As will be described in the following section, to select the set of stimuli that were used in the research, a study was conducted with 200 word-feature pairs, including some that were identified from the norms as well as other potential word-feature pairs. In this study, feature typicality ratings were collected from monolingual speakers of each language. From this larger set, 120 word and language-specific features were chosen for use in the current study, which is a far greater number of stimuli than was used in Dong et al. (2005).

The main purpose of the current study is to extend our current knowledge about semantic accents by testing the Shared (Distributed) Asymmetrical (SDA) model (Dong et al., 2005). This model assumes that bilinguals' conceptual knowledge is represented by three different conceptual components: L1-specific features, L2-specific-features, and common features that are shared between the languages. These features are assumed to be connected to L1 and L2 word forms with different strengths, and these connection strengths change depending on bilinguals' L2 proficiency. At the early stage of L2 learning, bilinguals are assumed to acquire L2 words by overextending the conceptual elements from their knowledge in L1, which results in strong semantic accents in their use of L2 words (i.e., L2 words have strong connection to L1-specific elements, so Japanese-English bilinguals activate somewhat different English word meanings than English monolinguals). With more L2 proficiency, bilinguals gradually acquire L2-specific conceptual elements (i.e., stronger connection between L2 and L2 elements), and weaken connections between L2 words and L1-specific elements. This leads them to have less of a semantic accent in their L2 (i.e., their L2 conceptual representation become more native-like). At this point, bilinguals' conceptual representations are asymmetrical (i.e. language-specific elements are connected strongly to the congruent language), which means that bilinguals activate somewhat different meanings for translation equivalent words depending on the language they use. However, cross-language connections between L1 words and L2-specific elements may also be developed, resulting in bilinguals exhibiting semantic accents in their L1 (e.g., Japanese-English bilinguals may activate somewhat different meanings for the L1 word *kabocha* compared to Japanese monolinguals due to their knowledge of English-specific elements). Currently, the SDA model seems to be the only feature-based model that provides specific predictions regarding how bilinguals' conceptual knowledge develops with increasing proficiency. However, few studies to date have empirically evaluated the claims of the model. By testing the predictions of the SDA model using different feature-based tasks (i.e., feature typicality rating, feature verification, lexical decision with semantic priming), the current study attempted to assess the connection strength between L1/L2 words and language-specific features.

In addition to testing the predictions of the SDA model, the present study also explores questions that have yet to be investigated. First, while the SDA model assumes that L2 proficiency has an impact on bilinguals' semantic accents, the influence of other factors related to bilinguals' language history, such as age of acquisition and cultural immersion, is unspecified in the model. Given that there have been several studies suggesting the degree of L2 immersion is a strong predictor of bilinguals' lexical categorization of objects (Malt & Sloman, 2003; Mok & Yu, 2017; Pavlenko & Malt, 2011; Zinszer, Malt, Ameel, & Li, 2014), the current study explores whether the length of residence (LOR) in L2 speaking countries can be another important factor that predicts bilingual semantic accents.

Secondly, another research question that I will address is that whether the type of features impacts the nature of semantic accents observed in bilinguals. In the monolingual literature, it has been suggested that the kind of feature influences how people recognize concepts (Ashcraft, 1978; Cree, McNorgan, & McRae, 2006; Solomon & Barsalou, 2001). In terms of a developmental perspective, Nelson, Frankenfield, Morries, and Blair (2000) found that children up to the age of four strongly rely on appearance rather than functional properties when categorizing artifacts. In bilinguals, it is possible that the type of feature affects how easily they can be acquired when learning a word meaning. For example, the semantic feature "is yellow" for the concept bus (which is more typical in Canadian culture) may be readily learned by observing the object. On the other hand, a feature such as "eaten at breakfast" for the concept fish (which is typical Japanese culture) is situational information that may be more difficult to learn because the knowledge comes from Japanese customs, not from just seeing the object itself. The word-feature pairs that were used in the current study were divided into two different types of critical stimuli; half of the pairs had culturally specific perceptual features and the rest had culturally specific situational features. These sets of stimuli were used to investigate whether feature type influences the development of semantic accents.

To summarize, the present study had three main goals: (1) test the predictions of the SDA model to provide more empirical evidence regarding the nature of bilinguals' semantic accents, (2) explore whether length of residency in a L2-speaking country impacts the nature of semantic accents, and (3) explore whether the degrees of semantic accent differ depending on the types of features. These issues will be addressed in all three experiments conducted in this study.

3.1.1 A Study for Stimuli Selection

In this study, I collected feature typicality ratings for 200 pairs of words and features from Japanese and English-speaking participants. The aim of this study was to obtain quantitative measures of typicality in order to select good culture-specific word and feature pairs (both situational and perceptual types) for the subsequent experiments. I selected 80 items, each with a corresponding feature that I thought was a Canadian specific feature, (e.g., *basement* – found in houses) and 90 items that each had a Japanese specific feature (e.g., *beer* – sold in vending machines). Twenty-six of the Canadian specific items and 25 of the Japanese specific items were selected from the norming data from Chapter 2. While more culture-specific pairs were initially identified in the norms, because some of them had the same features (e.g., both *public phone* and *pumpkin* had the same Japanese-specific feature "is green") not all of them were used to avoid repetition of features among the stimuli. Therefore, an effort was made to prepare a greater number of items. The experience gained from that project was helpful in selecting the additional 54 Canadian items and 65 Japanese items that were included in the pilot study. The feature-rating task also included 30 filler items, half of which were paired with highly typical features and half with highly atypical features. These pairs were included to help detect whether participants were completing the task carefully.

The participants were 20 Japanese speakers residing in Japan (6 female, mean age = 38.2 years, *SD* = 10.51) and 25 English speakers residing in Canada (16 female, mean age = 40.2 years, *SD* = 15.18). All participants were recruited via crowdsourcing websites (Lancers was used for collecting data from Japanese speakers, CrowdFlower was used for collecting data from English speakers) and they participated in the study online. Except for one Japanese speaker (who spent 17 years [out of 57 years] outside Japan) and one English speaker (who spent 4 years [out of 52 years] outside Canada), all participants had lived in their native country since they were born. The participants were asked to rate the typicality of those 200 pairs of words and features on a 1 (not typical at all) to 7 (very typical) scale. For English participants, the word-feature pairs were given in English, and for Japanese participants, the same 200 word-feature pairs were presented in Japanese. The task took approximately 30 minutes and the participants were paid $3 (270 yen for Japanese participants). English speakers rated the 80 items with Canadian-specific features as more typical (M = 5.60, SD = .67) compared to Japanese speakers (M = 3.59, SD = .32), and conversely, Japanese speakers rated the 90 items with Japanese-specific features as more typical (M = 5.21, SD = .33) compared to English speakers (M = 3.21, SD = .40).

Using these ratings, I selected 60 Japanese specific pairs (30 perceptual and 30 situational) and 60 Canadian specific pairs (30 perceptual and 30 situational) for use in the main experiments (see Appendix F). In selecting culture-specific items, I avoided repetition of words/features (e.g., *air conditioner* had several Japanese specific features such as “attached to wall” and “used with a remote controller) and removed low frequency items (e.g., *plank*, *incense*). English speakers rated both the 30 Canadian perceptual and the 30 Canadian situational items higher (perceptual: M = 5.44, SD = .74, situational: M = 5.77, SD = .60) compared to Japanese speakers (perceptual: M = 3.34, SD = 1.00, situational: M = 3.50, SD = .99). Japanese speakers rated both the 30 Japanese perceptual and the 30 Japanese situational items higher (perceptual: M = 5.33, SD = .75, situational: M = 5.39, SD = .89) compared to English speakers (perceptual: M = 2.95, SD = 1.00, situational: M = 3.09, SD = 1.21).

3.1.2 Overview of Experiments 1 to 3

The participants consisted of Japanese-English bilinguals either living in Japan or Canada, Japanese speakers residing in Japan, and English speakers residing in Canada. Using the culture-specific items selected in the previous rating study, I conducted the following three experiments: a feature typicality rating task (Experiment 1), a feature verification task (Experiment 2), and a semantic priming with lexical decision task (Experiment 3). The critical stimuli used were the same across all tasks (except that in the lexical decision task, features were presented in a short form [e.g., "is yellow" -> "yellow"]). The participants completed all three tasks. In order to minimize the influence of repeated exposure to the stimuli, all participants started from the implicit and time sensitive task. Thus, I asked all the participants to start from the lexical decision task (Experiment 3), followed by feature verification task (Experiment 2), and then the feature typicality rating task (Experiment 1).

Each task had English and Japanese versions. The bilingual participants were asked to do the three tasks in both language versions in order to investigate whether there is any difference when they are processing words in their L1 vs L2. In order to minimize the influence of completing the same tasks in different languages, the participants were asked to complete each language version of the tasks on two different days at least one week apart between the first and second sessions. All participants were also asked to complete a language background questionnaire and English and/or Japanese vocabulary tests. The scores on the English vocabulary test were used as the measure of the bilinguals' L2 proficiency (See 3.2.2.2). Each experimental session took approximately one hour to complete.

3.2 Experiment 1: Feature Typicality Rating Task

3.2.1 Introduction

The purpose of Experiment 1 was to test the predictions of the SDA model (Dong, Gui, & MacWhinney, 2005) using a feature typicality rating task. Participants were asked to rate the typicality of each word and feature pair on a scale of 0 to 100. They rated both Canadian-specific and Japanese-specific pairs in English and in Japanese. Using monolingual mean ratings as the baseline (two groups; Japanese and English), I examined how Japanese-English bilinguals' ratings in each of their languages differed from their monolingual counterparts. Evidence for a semantic accent in their L2 would come from finding that bilinguals' mean ratings in the English version of the task were different from English monolinguals, with higher ratings given for words paired with Japanese specific features (e.g., coin – has a hole) and lower ratings given for words paired with Canadian specific features (e.g., bus – is yellow) compared to English monolinguals. On the other hand, evidence for a semantic accent in Japanese (L1) would be obtained if in the Japanese version of the task bilinguals give lower ratings for words paired with Japanese specific features and higher ratings for words paired with Canadian specific features compared to Japanese monolinguals. Furthermore, if bilinguals activate somewhat different meanings of translation equivalents depending on the language they use (conceptual asymmetry between L1 and L2 processing), they should give higher ratings for culture-specific items when the language of the task is congruent. That is, they should rate words with Canadian specific features higher in the English (L2) version of the task than in the Japanese (L1) version, and they should rate words with Japanese specific features higher in the Japanese version of the task than in the English version. Additionally, if perceptual features (e.g., bus – is yellow) are easier to acquire compared to situational features (e.g., balloon – used for birthdays), bilinguals would rate Canadian (L2) perceptual features higher than Canadian situational features. Finally, if L2 proficiency impacts bilinguals' conceptual representations in the way that the SDA model predicts, higher proficiency should lead bilinguals to have ratings closer to English monolinguals and further from Japanese monolinguals. A similar pattern of results is expected to be found if L2 Cultural Exposure also influences semantic accents.

3.2.2 Method

3.2.2.1 Participants

Bilinguals. Ninty-nine Japanese-English bilingual participants were recruited (37 male, mean age = 28.1 years). Forty-nine of them (27 male, mean age = 21.2 years) were recruited in Japan (Waseda University, Tokyo) and 50 of them (10 male, mean age = 34.9 years) were recruited in Canada (London and Toronto, Ontario). The bilinguals were recruited in both Japan and Canada in order to obtain participants with different degrees of L2 Cultural Exposure. The mean number of years residing in English-speaking countries ranged from 0 to 22 years (mean = 7.7 years, *SD* = 8.9). All participants' first language was Japanese and they also had good English proficiency. For the data collection in Japan, there was a participation eligibility criterion (a score of 700 or higher on the Test of English for International Communication [TOEIC]) in order to make sure that the participants had good knowledge of English. The participants recruited in Canada received $15 for their participation in each session and those recruited in Japan received similar compensation but in the form of book card (worth 1500 yen).

English Monolinguals. Forty-nine English speakers (12 male, mean age = 19.4 years) were recruited at Western University, Canada. All participants were born in Canada and had English as their first language. Their knowledge of a second language was none or minimal. The participants received a course credit for their participation.

Japanese Monolinguals. Forty-four Japanese monolinguals (16 male, mean age = 19.5 years) were recruited at Waseda University, Japan. All participants were born in Japan and had Japanese as their first language. All Japanese monolinguals had at least some knowledge of English, because English is a part of compulsory education in Japan. However, none of them met the bilingual eligibility (i.e., 700 or higher score on the TOEIC) and thus they were classified as monolinguals.

3.2.2.2 Materials

Questionnaire. The participants completed the language background questionnaire at the beginning of the experiment. Items used in the questionnaire were based on the LEAP-Questionnaire (Marian, Blumenfeld, & Kaushanskaya, 2007). In this questionnaire, bilinguals were asked to indicate how long they had lived in any English-speaking countries. English monolinguals completed the questionnaire in English and Japanese monolinguals and bilinguals completed the questionnaire in Japanese. This questionnaire took approximately 10 minutes to complete.

Vocabulary Tests. Japanese and English vocabulary tests were administered to assess participants' language proficiency. Each vocabulary test consisted of 40 words and 20 nonword items (see Appendix G) and the participants were asked to indicate if they were real words or nonwords. The word items used for the Japanese vocabulary test were taken from the NTT vocabulary estimation test (Amano & Kondo, 1999) and the nonwords were created by reordering the characters of real Japanese words. Both word and nonword items used for English vocabulary test were taken from LexTale (Lemhöfer & Broersma, 2012). These vocabulary tests were created on the Qualtrics platform and participants completed them using a computer. The Japanese vocabulary test was completed by Japanese monolinguals and bilinguals, and the English vocabulary test was completed by all participants. The test took approximately 5 to 10 minutes. The tests were scored using the sensitivity index (*d*') instead of percentage correct in order to take into account false alarms. The descriptive data from the vocabulary tests are summarized in Table 3.1.

Table 3. 1. Vocabulary Test Descriptive Data

	English Mean *d*' (*SD*)	Japanese Mean *d*' (*SD*)
English Monolinguals	2.69 (0.81)	n/a
Japanese Monolinguals	0.79 (0.44)	2.23 (0.47)
Bilinguals	1.24 (.80)	1.91 (0.53)

Stimuli. The critical stimuli consisted of 120 culture-specific word and feature pairs. Sixty pairs were Canadian-specific pairs (30 perceptual and 30 situational) and the other 60 pairs (30 perceptual and 30 situational) were Japanese-specific pairs (See Appendix F). These critical stimuli were presented in two language versions (English and Japanese) and used in all three tasks. Word frequency was obtained from the SUBTLEX Word Frequency database (Brysbaert & New, 2009) for the English stimuli and the NTT database (Amano & Kondo, 2000) for the Japanese stimuli (See Table 3.2). For the feature typicality rating and feature verification tasks, 60 culturally-neutral filler pairs were also included. Thirty of the pairs were highly typical (e.g., SNOW – is cold) and the other 30 pairs were not typical at all (e.g., BALL – is square).

Table 3. 2. Mean Word Frequency (per million) of Critical Stimuli (*SD* in brackets)

English		Japanese	
Word	Feature	Word	Feature
31.89 (83.23)	41.26 (71.83)	19.18 (55.71)	16.27 (28.20)

3.2.2.3 Procedure

Participants were asked to rate the typicality of each of the 180 pairs of words (e.g., "BUS") and features (e.g, "is yellow") using slider scales ranging from 0 (not typical at all) to 100 (very typical). The order of stimuli was randomized for each participant. The task was created on the Qualtrics platform and it took approximately 15 minutes to complete.

3.2.3 Results

3.2.3.1 Analyses Overview

Three different analyses were conducted. The first analysis involved comparisons of bilinguals and monolinguals in each language (English, Japanese) in order to observe whether semantic accents occur in bilinguals' L1 and L2. In this analysis, five English monolinguals and three Japanese monolinguals were excluded either due to high error rates on the lexical decision task or to some knowledge of Japanese (one English monolingual). The second analysis involved comparisons across languages within the bilingual group. The aim of this analysis was to investigate whether the access to culture-specific features differs depending on the language used for the task. In this analysis, five bilinguals were excluded because they did not complete the tasks in both languages. Finally, the last analysis was conducted to explore whether bilinguals' access to culture-specific features depends on individual differences, including L2 proficiency and L2 cultural exposure. The data were analyzed using linear mixed models or generalized linear mixed models within the lme4 package (Bates, Maechler, Bolker, & Walker, 2015) of R (R Core Team, 2012).

3.2.3.2 Analysis Procedure

The feature typicality rating data were analyzed using linear mixed models. The relevant fixed factors are included for each analysis, and random intercepts for subject and items were included for all models. Random slopes were determined by comparing models with different random slopes. Omnibus tests were carried out to find any significant main effects and interactions. Of all original data, 4.5% of the English data and 0.9% of the Japanese data were not included in the analyses because the participants did not give any ratings for those items.

3.2.3.3 Comparisons between Bilinguals and Monolinguals

Model. The goal of the analyses was to find out whether there is any difference between bilinguals (regardless of immersion) and monolinguals in their feature typicality ratings in each language and whether the Participant Group interacts with Culture Pair and Feature Type. Fixed factors included: Group (Monolingual vs. Bilingual; sum coded), Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), and their interaction terms. Random factors included: subject (random intercept and random slope adjustment for Culture Pair) and items (random intercept only).

English feature typicality ratings. The model for English feature typicality ratings is presented in Table 3.3. First, there was a significant main effect for Culture Pair (χ^2 (1) = 115.93, $p < .001$), but no significant main effects were found for Group (χ^2 (1) = 2.49, $p = .11$) or Feature Type (χ^2 (1) = 0.003, $p = .96$). Most importantly, there was a significant Group x Culture Pair (χ^2 (1) = 396.67, $p < .001$) interaction. As seen in Figure 3.1, bilinguals gave lower ratings for pairs with Canadian-specific features and higher ratings for pairs with Japanese-specific features than did English monolinguals. There was also a Group x Feature Type interaction (χ^2 (1) = 26.37, $p < .001$), but not a significant Culture Pair x Feature Type interaction (χ^2 (1) = 1.48, $p = .22$). Finally, there was a significant Group x Culture Pair x Feature Type interaction (χ^2 (1) = 23.02, $p < .001$). The difference between the bilinguals and English monolinguals was particularly evident for pairs with Japanese-specific situational features.

Table 3. 3. Model for Group Comparisons of English Feature Typicality Ratings

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	62.17	1.40	44.26	$p < .001$
Group	-2.68	1.70	-1.58	*ns*
Culture	-27.25	2.53	-10.77	$p < .001$
Feature Type	0.13	2.29	0.06	*ns*
Group x Culture Pair	-47.10	2.36	-19.92	$p < .001$
Group x Feature Type	-5.11	0.99	-5.14	$p < .001$
Culture x Feature Type	-5.55	4.56	-1.22	*ns*
Group x Culture Pair x Feature Type	-8.46	1.76	-4.80	$p < .001$

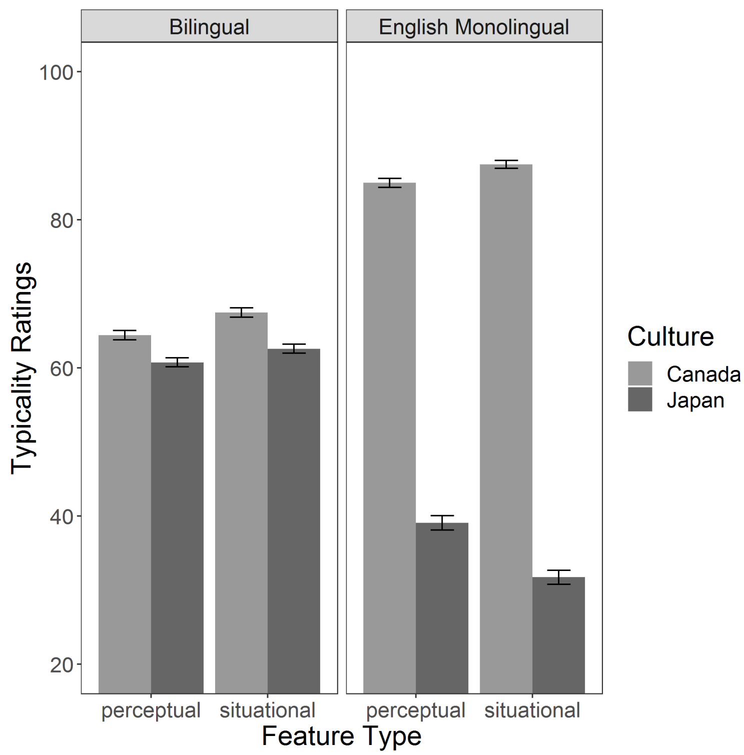

Figure 3. 1. Group comparisons of English feature typicality ratings. Culture refers to whether the items had Canadian-specific or Japanese-specific features.

Japanese feature typicality ratings. The model for Japanese feature typicality ratings is presented in Table 3.4. There were significant main effects for Group (χ^2 (1) = 9.92, $p < .01$) and Culture Pair (χ^2 (1) = 53.28, $p < .001$). However, no significant main effect was found for Feature Type (χ^2 (1) = 1.00, $p = .32$). More importantly, the Group x Culture Pair interaction was significant (χ^2 (1) = 32.48, $p < .001$). Post hoc comparisons revealed that bilinguals gave higher ratings for pairs with Canadian-specific features than Japanese monolinguals ($t = -5.00$, $p < .001$), but both groups gave similar ratings for pairs with Japanese-specific features ($t = 0.40$, $p = .69$) (See Figure 3.2).

Table 3. 4. Model for Group Comparisons of Japanese Feature Typicality Ratings

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	65.83	1.60	41.26	$p < .001$
Group	-5.82	1.85	-3.15	$p < .01$
Culture	20.76	2.84	7.30	$p < .001$
Feature Type	2.64	2.63	1.00	*ns*
Group x Culture Pair	13.12	2.30	5.70	$p < .001$
Group x Feature Type	-0.53	0.83	-0.65	*ns*
Culture x Feature Type	-5.86	5.27	-1.11	*ns*
Group x Culture Pair x Feature Type	-1.81	1.65	-1.10	*ns*

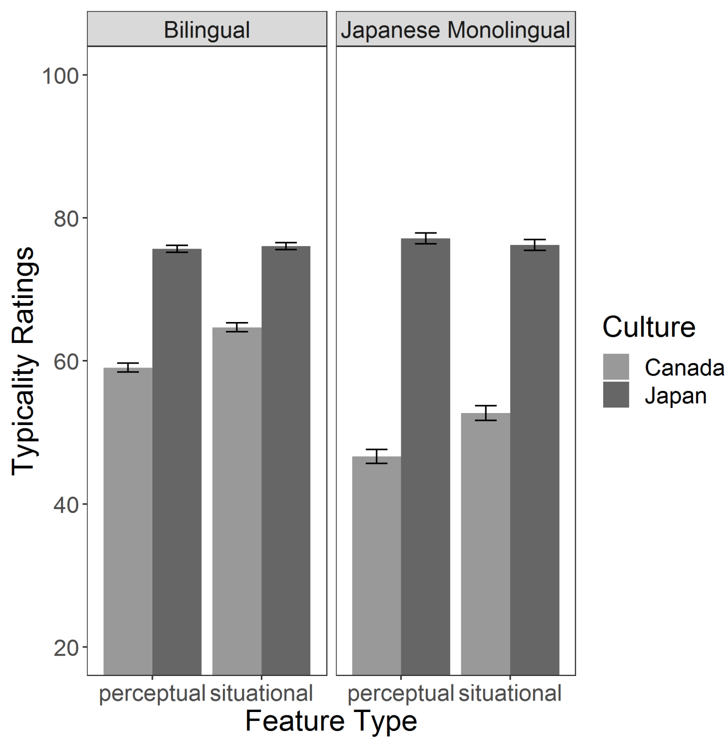

Figure 3. 2. Group comparisons of Japanese feature typicality ratings.

3.2.3.3 L1 vs. L2 Task Comparisons within Bilinguals

Model. The goal of the analyses was to investigate whether bilinguals' typicality ratings depend on the language of the task (recall that bilinguals rated pairs with Canadian-specific and Japanese-specific features in both English and Japanese), and whether Language interacts with Culture Pair and Feature Type. Fixed factors included: Language (English vs. Japanese, sum coded), Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), and their interaction terms. Random factors included: subject (random intercept and random slope adjustment for Language, Culture, and Feature Type) and items (random intercept only).

Results. The model for L1 vs L2 comparisons of typicality ratings is presented in Table 3.5. First, there was a significant main effect for Language (χ^2 (1) = 37.98, $p < .001$), with higher ratings on average when the task was done in Japanese than when it was done in English, and a marginally significant effect for Culture Pair (χ^2 (1) = 3.80, $p = .05$). There was no significant effect for Feature Type (χ^2(1) = 1.49, $p = .22$). Importantly, there was a significant Language x Culture Pair interaction (χ^2 (1) = 640.87, $p < .001$). The language of the task had a bigger impact on ratings of Japanese cultural pairs than Canadian cultural pairs. As seen in Figure 3.3, bilinguals' ratings for pairs with Japanese-specific features were considerably higher when the task was in Japanese than when it was in English, whereas their ratings for pairs with Canadian-specific features were only modestly higher when they completed the ratings in English compared to Japanese. No other two-way interactions were significant, but there was a Language x Culture Pair x Feature Type interaction (χ^2 (1) = 6.27, $p < .05$). The language of the task did not differentially affect ratings of Japanese perceptual and situational pairs, but it did have a somewhat larger impact on Canadian perceptual pairs than situational pairs.

Table 3. 5. Model of L1 vs L2 Comparisons for Typicality Ratings

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	66.16	1.49	44.26	$p < .001$
Language	5.16	0.84	6.16	$p < .001$
Culture	5.24	2.69	1.95	$p = .05$
Feature Type	2.85	2.34	1.22	*ns*
Language x Culture Pair	17.55	0.69	25.32	$p < .001$
Language x Feature Type	0.34	0.69	0.50	*ns*
Culture x Feature Type	-3.16	4.64	-0.68	*ns*
Language x Culture Pair x Feature Type	-3.47	1.39	-2.50	$p < .05$

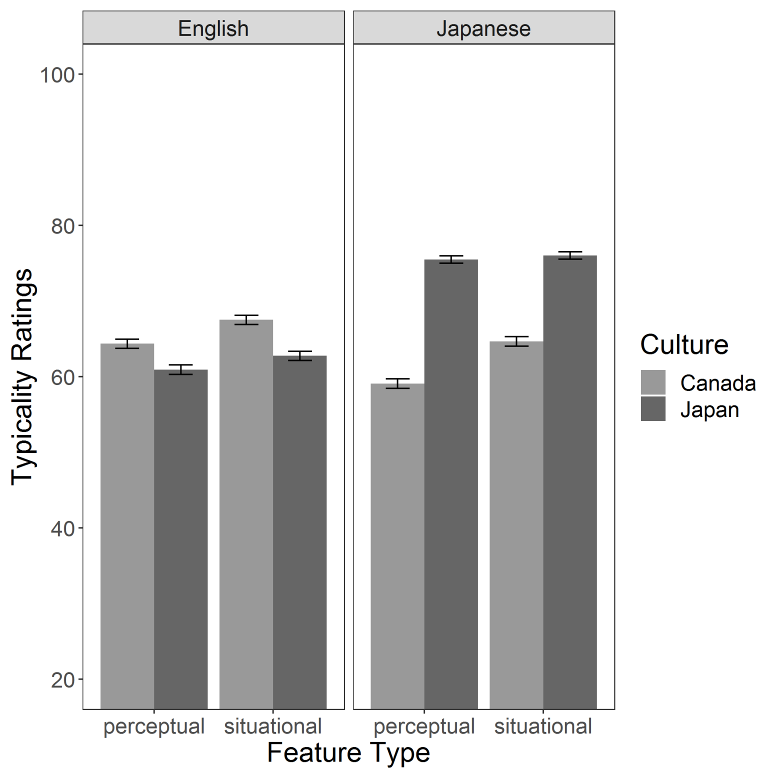

Figure 3. 3. L1 vs L2 comparisons for typicality ratings.

3.2.3.3 The Effects of Individual Differences

Model and procedure. The goal of the analyses was to find out whether individual differences (L2 Proficiency and Cultural Exposure) have any influence on bilinguals' typicality ratings. L2 proficiency is based on the *d*' scores from the English vocabulary test and Cultural Exposure is the number of years lived in an English-speaking country. I started the analyses with a baseline model (Model 0) that included the main effects of the four fixed factors: Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), L2 Proficiency (continuous; scaled), and L2 Cultural Exposure (continuous; scaled). For random effects, I included intercepts for subjects and items, as well as the by-subject random slope for the Culture Pair and the by-item random slope for the effect of L2 Cultural Exposure. To examine whether the interaction between Culture Pair and each of the other three fixed variables improved the model fit, I performed a series of model comparisons using the likelihood ratio test by incrementally adding the interaction terms to the baseline model. In reporting the results for each task, the first paragraph describes the process of determining the model that provides the best fit, and the next paragraph describes the nature of the effects in the final model.

English (L2) task. The baseline model is shown in Table 3.6. First, the addition of the Culture Pair x Feature Type interaction to the baseline model did not improve the model fit (Model 1; χ^2 (1) = .29, p = .59). Second, the addition of the Culture Pair x L2 Proficiency interaction to the baseline model significantly improved the model fit (Model 2; χ^2 (1) = 5.78, $p < .05$). Third, the addition of the Culture Pair x Cultural Exposure interaction to the baseline model also yielded significant improvement of the fit (Model 3; χ^2 (1) = 39.40, $p < .001$). Furthermore, the addition of both the Culture Pair x L2 Proficiency and the Culture Pair x Culture Exposure interactions to the baseline model (Model 4) provided a better fit compared to Model 2 with the Culture Pair x L2 Proficiency interaction alone (Model 4; χ^2 (1) = 33.78, $p < .001$), but did not improve the fit compared to Model 3 with the Culture Pair x Cultural Exposure interaction alone (Model 4; χ^2 (1) = .16, p = .69). These results imply that the model fit was improved by the addition of the Culture Pair x Cultural Exposure interaction but not the further addition of the Culture Pair x L2 Proficiency interaction. The numerical comparison of negative log likelihood revealed that the model with the Culture Pair x Cultural Exposure interaction (-51866) has a better fit compared to the model with the Culture Pair x L2 Proficiency interaction (-52167).

Based on the model selection process above, Model 3 has the best fit (see Table 3.6). The model consists of the main effects of the four variables (Culture Pair, Feature Type, L2 Proficiency, Cultural Exposure) and the Culture Pair x Cultural Exposure interaction. In this model, the main effect of Cultural Exposure was marginally significant (χ^2 (1) = 3.83, *p* = .05), indicating that more L2 Cultural Exposure leads to higher overall typicality ratings. Most importantly, the Culture Pair x Culture Exposure interaction was significant (χ^2 (1) = 44.41, $p > .001$). Post hoc comparisons revealed that more L2 Cultural Exposure leads to higher ratings for pairs with Canadian-specific features ($t = 5.15$, $p < .001$), and marginally lower ratings for pairs with Japanese-specific features ($t = -1.67$, $p = .10$) (See Figure 3.4). After many years of L2 cultural exposure, the bilinguals' ratings for pairs with Canadian-specific features approached the ratings of monolingual English speakers, but their ratings for pairs with Japanese-specific features remained significantly higher than those of English monolinguals even after a lengthy stay.

One important issue that needs to be addressed in these individual differences analyses is the fact that L2 Proficiency and L2 Cultural Exposure are correlated ($r = .48$, $p < .001$) and they suffer from mild collinearity ($k = 13.19$). Thus, the results reported above need to be further investigated to determine whether the effect of L2 Proficiency is truly absent. To do this, I employed stratification, which allows me to test the effect of L2 Proficiency while keeping the L2 Cultural Exposure variable constant by analyzing a subset of the data. More specifically, I tested a model to see if there is a Culture Pair x L2 Proficiency interaction based on data from bilinguals who have never lived in L2 speaking countries ($n = 32$). Fixed factors included: Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), L2 Proficiency (continuous), and their interaction term. Random factors included: subject (random intercept and random slope adjustment for Culture Pair) and items (random intercept and random slope adjustment for L2 Proficiency). As seen in Figure 3.5, there was no significant Culture Pair x L2 Proficiency interaction (χ^2 (1) = 1.05, $p = .31$), which means that L2 proficiency does not differentially influence the typicality ratings for the Canadian-specific and Japanese-specific Culture Pairs. In summary, the results of the best fit model (Model 3) are likely to be valid, because the effect of L2 Proficiency is still absent when L2 Cultural Exposure is kept constant.

Table 3. 6. Baseline (Model 0) and Best Fit (Model 3) Models for the English Typicality Rating Task

	Model 0				Model 3			
Fixed-effects	*b*	*SE*	*t*	*p*	*b*	*SE*	*t*	*p*
Intercept	63.31	1.62	39.01	$p < .001$	63.31	1.61	39.37	$p < .001$
Culture Pair	-8.61	2.70	-3.19	$p < .01$	-3.87	2.7	-1.43	*ns*
L2 Proficiency	-0.16	1.13	-0.14	*ns*	-0.16	1.13	-0.14	*ns*
Culture Exposure	2.71	1.24	2.19	$p < .05$	2.39	1.22	1.96	$p = .05$
Feature Type	2.32	2.27	1.02	*ns*	2.32	2.27	1.02	*ns*
Culture Pair x Culture Exposure	-	-	-	-	-9.59	1.44	-6.66	$p < .001$

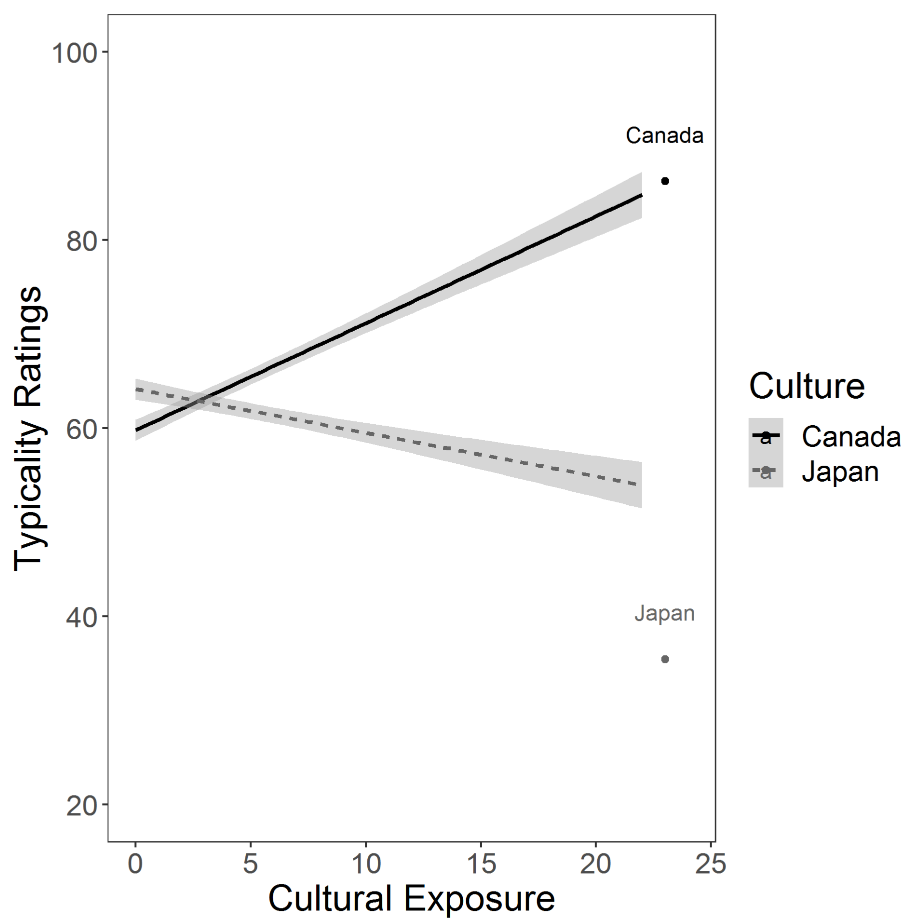

Figure 3. 4. The Culture Pair (Canadian vs Japanese pairs) x L2 Cultural Exposure (in years) interaction effect on English typicality ratings. The dots indicate the mean typicality ratings given by monolingual English participants.

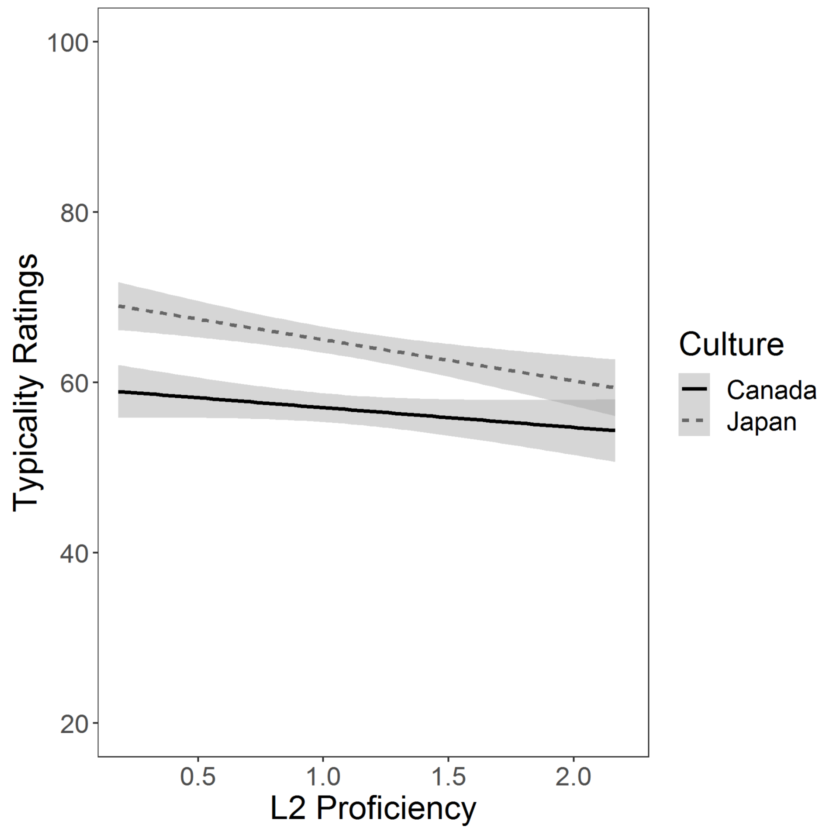

Figure 3. 5. The absence of a Culture Pair (Canadian vs Japanese pairs) x L2 Proficiency (in d') interaction effect on English typicality ratings for bilinguals with no L2 cultural exposure.

Japanese (L1) task. The results of the model selection for Japanese typicality ratings were quite similar to those found for English typicality ratings. The baseline model is shown in Table 3.7. First, the addition of the Culture Pair x Feature Type interaction to the baseline model did not improve the model fit (Model 1; χ^2 (1) = 0.95, p = .33). Second, the addition of the Culture Pair x L2 Proficiency interaction to the baseline model marginally improved the model fit (Model 2; χ^2 (1) = 3.54, p = .06). Third, the addition of the Culture Pair x Cultural Exposure interaction to the baseline model yielded significant improvement of the fit (Model 3; χ^2 (1) = 53.58, $p < .001$). Furthermore, the addition of both the Culture Pair x L2 Proficiency and the Culture Pair x Cultural Exposure interactions to the baseline model (Model 4) provided a better fit compared to Model 1 with the Culture Pair x L2 Proficiency interaction alone (Model 4; χ^2 (1) = 50.36, $p < .001$), but did not improve the fit compared to Model 2 with the Culture Pair x Cultural Exposure interaction alone (Model 4; χ^2 (1) = .32, p = .57). These results imply that the model fit was improved by the addition of the Culture Pair x Cultural Exposure interaction but not by the further addition of the Culture Pair x L2 Proficiency interaction. The numerical comparison of negative log likelihood revealed that the model with the Culture Pair x Cultural Exposure interaction (-53332) has a better fit compared to the model with the Culture Pair x L2 Proficiency interaction (-53357).

Based on the model selection process above, Model 3 (see Table 3.7) has the best fit. The model consists of the main effects of the four variables (Culture Pair, Feature Type, L2 Proficiency, and Cultural Exposure) and the Culture Pair x Culture Exposure interaction. There was a significant main effect of Culture Pair (χ^2 (1) = 27.83, $p < .001$), indicating the overall typicality ratings were higher for pairs with Japanese-specific features compared to pairs with Canadian-specific features. The main effect of Cultural Exposure was also significant (χ^2 (1) = 4.72, $p > .05$), indicating that more L2 Cultural Exposure leads to higher overall typicality ratings. Most importantly, the Culture Pair x Culture Exposure interaction was significant (χ^2 (1) = 63.58, $p < .001$). Post hoc comparisons revealed that more L2 Cultural Exposure leads to higher ratings for pairs with Canadian-specific features ($t = 5.32$, $p < .001$), but lower ratings for pairs with Japanese-specific features ($t = -2.15$, $p < .001$) (See Figure 3.6). That is, with more time in the L2 culture, typicality ratings diverge more from those of monolingual Japanese participants.

As in the analyses of English typicality ratings, stratification was used to evaluate the results obtained above, using the data from 32 bilinguals with no L2 Cultural Exposure. Fixed factors included: Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), L2 Proficiency (continuous), and their interaction term. Random factors included: subject (random intercept and random slope adjustment for Culture Pair) and items (random intercept and random slope adjustment for L2 Proficiency). As seen in Figure 3.7, there was no significant Culture Pair x L2 Proficiency interaction (χ^2 (1) = 0.10, $p = .75$). In summary, the results of the best fit model (Model 3) are likely to be valid, because the effect of the L2 proficiency is still absent when L2 Cultural Exposure is kept constant.

Table 3. 7. Baseline (Model 0) and Best Fit (Model 3) Models for the Japanese Typicality Rating Task

	Model 0				Model 3			
Fixed-effect	*b*	*SE*	*t*	*p*	*b*	*SE*	*t*	*p*
Intercept	68.74	1.61	42.76	$p < .001$	68.74	1.59	43.35	$p < .001$
Culture Pair	10.37	2.75	3.78	$p < .001$	14.21	2.70	5.28	$p < .001$
L2 Proficiency	-0.63	1.02	-0.62	*ns*	-0.63	1.02	-0.62	*ns*
Culture Exposure	0.53	1.11	0.47	*ns*	2.43	1.12	2.17	$p < .05$
Feature Type	3.39	2.41	1.4	*ns*	3.40	2.41	1.41	*ns*
Culture Pair x Culture Exposure	-	-	-	-	-9.83	1.23	-7.97	$p < .001$

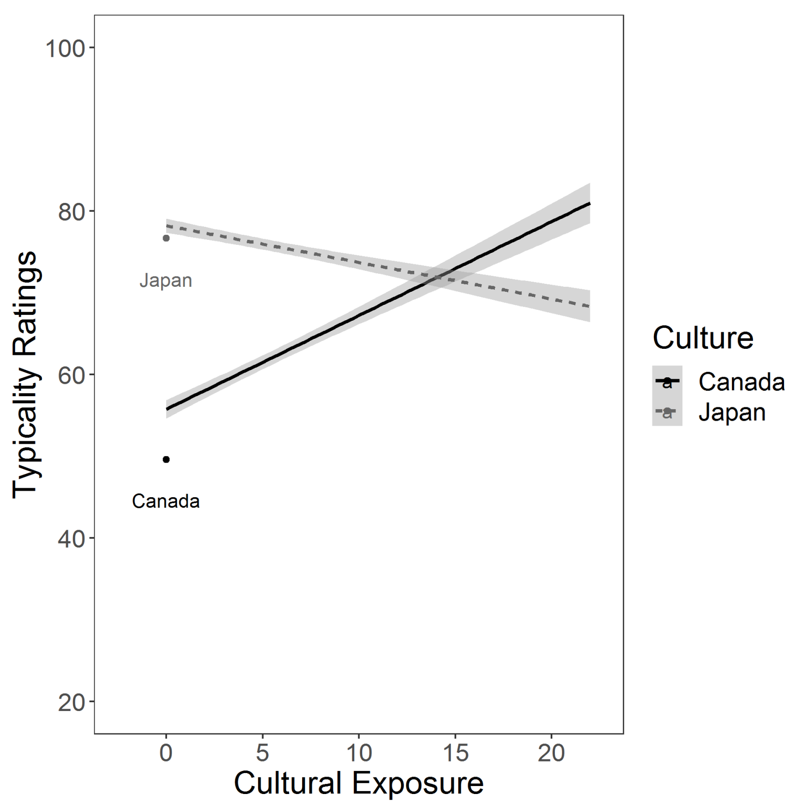

Figure 3. 6. The Culture Pair (Canadian vs Japanese pairs) x L2 Cultural Exposure (in years) interaction effect on Japanese typicality ratings. The dots indicate the mean typicality ratings given by monolingual Japanese participants.

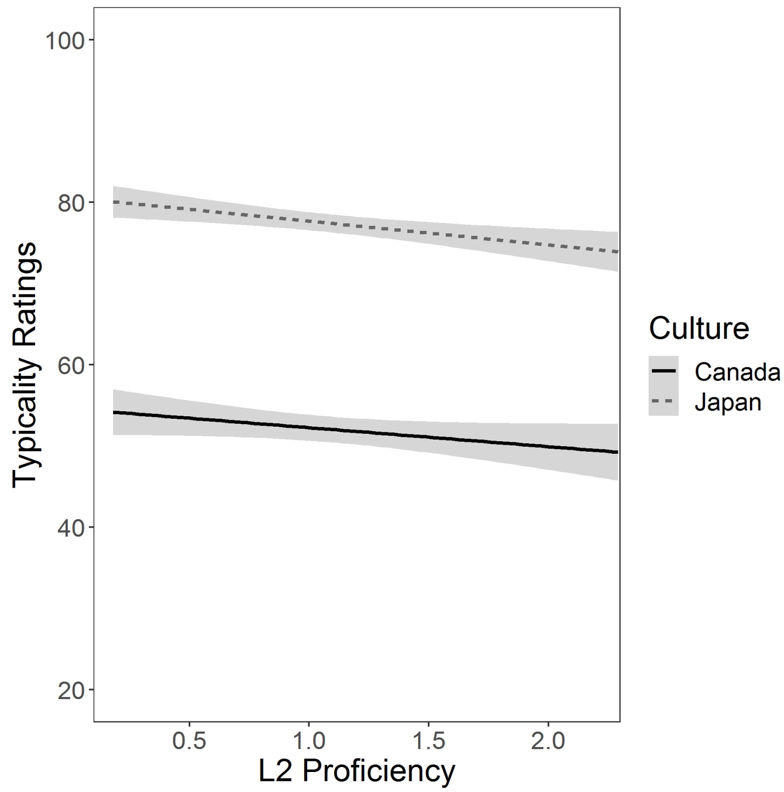

Figure 3. 7. The absence of a Culture Pair (Canadian vs Japanese pairs) x L2 Proficiency (in d') interaction effect on Japanese typicality ratings for bilinguals with no L2 cultural exposure.

3.2.4 Summary

Bilinguals' pattern of typicality ratings was unlike that of monolinguals in either language. When the rating task was in English, bilinguals gave lower ratings for pairs with Canadian-specific features but higher ratings for pairs with Japanese-specific features compared to English monolinguals, whereas when the rating task was in Japanese, they gave higher ratings for pairs with Canadian-specific features but similar ratings for pairs with Japanese-specific features in comparison to Japanese monolinguals. As predicted in the SDA model, these results demonstrate that the bilinguals have weaker L2 word – L2 feature links and stronger L2 word – L1 feature links compared to English monolinguals, suggesting the existence of semantic accents in their L2. On the other hand, they have stronger L1 word – L2 feature links than Japanese monolinguals, suggesting that they have semantic accents in L1 as well. Furthermore, the typicality ratings even differed within bilinguals for the same items depending on the language of the task. Bilinguals gave higher ratings for the Canadian cultural pairs when the task was in English than when the task was in Japanese, whereas they gave higher ratings for the Japanese cultural pairs when the task was in Japanese than when the task was in English. That is, ratings were higher when the language of the task was culturally congruent. Contrary to the expectation, feature type did not influence bilinguals' typicality ratings. These results suggest that the bilinguals on average exhibited conceptual asymmetry of L1 and L2, which was assumed in the SDA model. Finally, typicality ratings were influenced by the number of years of exposure to the L2 culture, and not by L2 proficiency. Interestingly, it appears to take many years of cultural exposure before English typicality ratings for Canadian cultural pairs approach those of English monolinguals, and in the meantime, English typicality ratings for Japanese cultural pairs decline, although not to the level of English monolinguals. There was also a decline in Japanese typicality ratings for Japanese cultural pairs with increasing exposure to the L2 culture, along with the expected increase in ratings for Canadian cultural pairs. This finding contradicts the assumption of the SDA model that L2 proficiency is an important predictor. In this study, the length of residence in an English-speaking country seems to have a significant impact on the connection strengths between L1/L2 words and features.

3.3 Experiment 2: Feature Verification Task

3.3.1 Introduction

The aim of Experiment 2 was to investigate whether semantic accents and the effects of individual differences observed in the feature typicality rating task (Experiment 1) are also observed in a feature verification task. Feature verification is a task where participants are asked to make a binary judgment on whether a certain feature (e.g., barks) is reasonably true for a given word (e.g., dog). In the monolingual literature, the feature verification task has been used in many studies to infer the effects of various factors influencing the association between a word and a feature (Ashcraft 1978; McRae, Cree, Westmacott, & de Sa, 1999; Solomon & Barsalou, 2001).

There are two reasons why I conducted an experiment using a feature verification task. First, the feature typicality task that was used in Experiment 1 is an untimed task that involves conscious judgment, and it is possible that bilingual participants may give ratings knowing the intent of the study, particularly when they complete the ratings the second time in their other language. Feature verification, on the other hand, is a time sensitive task where participants are asked to respond as soon as possible, reducing the chance for the participants to realize the intent of the study. Therefore, if the results from the rating task are also observed in a time sensitive task, it would provide stronger evidence for the SDA model. Secondly, unlike a rating study, the feature verification task requires participants to make a binary decision. Whether or not they judge that a certain feature belongs to a word provides another way to assess bilingual semantic accents.

Verification rates and latency were measured to investigate semantic accents and the effects of individual differences in bilinguals. On each trial, participants saw a feature first, and then were presented with a word. The reason why features were presented before the words is that some features were longer than others in number of letters, which would result in differences in the time needed to process the phrases. Thus, features were presented prior to the word in order to avoid having reaction time differences due to the differences in the feature length.

3.3.2 Method

3.3.2.1 Participants

The participants were identical to Experiment 1.

3.3.2.2 Stimuli

The stimuli were identical to Experiment 1, that is, they consisted of 120 pairs of words and features that are culture-specific (60 Canadian and 60 Japanese) and culturally-neutral filler pairs (30 related and 30 unrelated).

3.3.2.3 Procedure

Participants were asked to determine whether a feature (e.g., "is yellow") is reasonably true for a given word (e.g., "BUS"). On each trial, a fixation point was presented for 500 ms, followed by the feature, which was presented for 1500 ms. Finally, the word was presented until the participant made response or for up to 2000 ms. All participants did 10 practice trials before they started the experimental task. The total number of trials was 180. The task took approximately 10 minutes to complete. The task was programmed using the DMDX software package (Forster & Forster, 2003).

3.3.3 Results

3.3.3.1 Analysis Procedure

Verification rates were analyzed using generalized linear mixed models (due to the binary nature of the response) and verification latency data (log transformation was used instead of raw reaction times) were analyzed using linear mixed models. The relevant fixed factors were included for each analyses and random intercepts for subject and items were included for all models. Random slopes were determined by comparing models with different random slopes. Omnibus tests were carried out to find any significant main effects and interactions. Words for which a participant did not give a typicality rating were assumed to be unknown to the participant, and the data from those items were not included in the analyses. Consequently, 4.5% of responses in English task and 0.9% of responses in Japanese tasks from bilinguals' data were removed from the following analyses.

3.3.3.2 Comparisons between Bilinguals and Monolinguals

Model. The goal of the analyses was to find out whether there is any difference between bilinguals and monolinguals in their performance on the feature verification task in each language and whether the group of participants interacts with Culture Pair and Feature Type. Fixed factors for models in each language included: Group (Monolingual vs. Bilingual; sum coded), Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), and their interaction terms. Random factors included: subject (random intercept and random slope adjustment for Culture and Feature Type) and items (random intercept only).

English Feature Verification Task

Verification rates. The model for English feature verification rates is presented in Table 3.8. First, there were significant main effects for Group (χ^2 (1) = 33.39, $p < .001$) and Culture Pair (χ^2 (1) = 63.69, $p < .001$). There was no significant main effect for Feature Type (χ^2 (1) = 0.13, $p = .72$). More importantly, there was significant Group x Culture Pair interaction (χ^2 (1) = 210.29, $p < .001$). Post hoc comparisons revealed that bilinguals' verification rates for pairs with Canadian-specific features were considerably lower than the verification rates of English monolinguals ($t = 10.27$, $p < .001$) and their verification rates for pairs with Japanese-specific features were higher than those of English monolinguals ($t = -2.31$, $p < .05$) (See Figure 3.8). No other interaction was significant; Group x Feature Type (χ^2 (1) = 0.27, $p = .60$), Culture Pair x Feature Type (χ^2 (1) = 0.53, $p = .47$), and Group x Culture Pair x Feature Type (χ^2 (1) = 1.52, $p = .22$).

Table 3. 8. Model of Group Comparisons of English Feature Verification Rates

Fixed-effects	*b*	*SE*	*z*	*p*
Intercept	1.41	0.08	18.28	$p < .001$
Group	0.57	0.10	5.78	$p < .001$
Culture Pair	-1.04	0.13	-7.98	$p < .001$
Feature Type	-0.05	0.13	-0.36	*ns*
Group x Culture Pair	-1.55	0.11	-14.50	$p < .001$
Group x Feature Type	0.05	0.10	0.52	*ns*
Culture x Feature Type	-0.19	0.26	-0.73	*ns*
Group x Culture Pair x Feature Type	-0.23	0.19	-1.23	*ns*

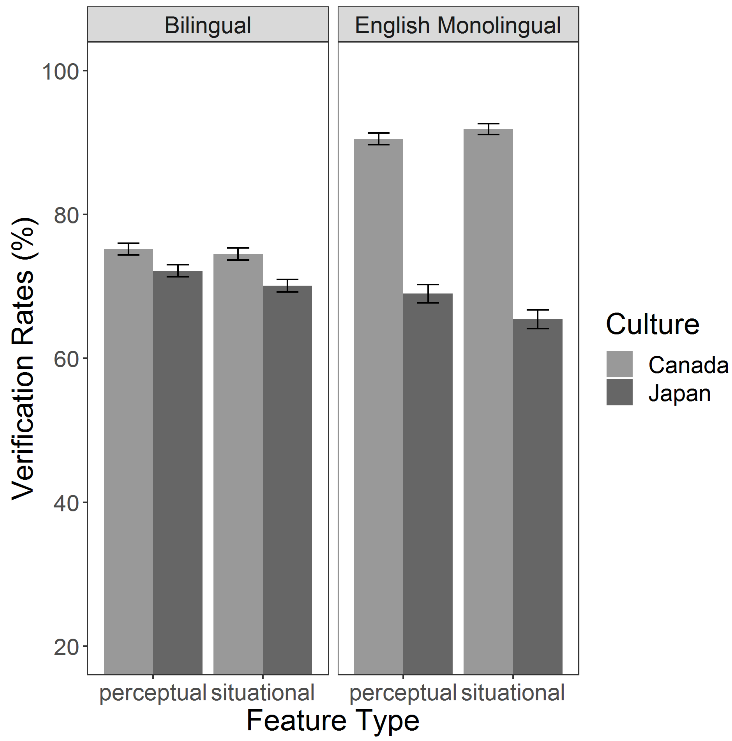

Figure 3. 8. Group comparisons of English feature verification rates.

Verification latency. The NO responses (19.7% of the original data) and then RT outliers (the residuals greater than 2.5 standard deviation in absolute values; 0.1% of the original data) were removed from the analyses. The model for English feature verification latency is presented in Table 3.9. First, there was a significant main effect for Group (χ^2 (1) = 95.99, p < .001) and no significant main effect for Culture Pair (χ^2 (1) = 2.20, p = .14). There was a significant Group x Feature Type interaction (χ^2 (1) = 22.02, p < .001), but other two-way interactions were not significant: Group x Culture Pair (χ^2 (1) = 0.68, p = .41) and Culture Pair x Feature Type (χ^2 (1) = 0.68, p = .41). There was, however, a significant Group x Culture Pair x Feature Type interaction (χ^2 (1) = 9.69, p < .01). As seen in Figure 3.9, bilinguals had slower verification latencies than English monolinguals, particularly for pairs with Japanese situational features.

Table 3. 9. Model of Group Comparisons of English Feature Verification Latency

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	2.9855	0.0073	408.80	$p < .001$
Group	-0.1223	0.0125	-9.80	$p < .001$
Culture Pair	0.0119	0.0080	1.48	*ns*
Feature Type	-0.0009	0.0080	-0.11	*ns*
Group x Culture Pair	0.00428	0.0052	0.82	*ns*
Group x Feature Type	-0.0226	0.0048	-4.69	$p < .001$
Culture x Feature Type	0.0130	0.0159	0.82	*ns*
Group x Culture Pair x Feature Type	-0.0293	0.0094	-3.11	$p < .01$

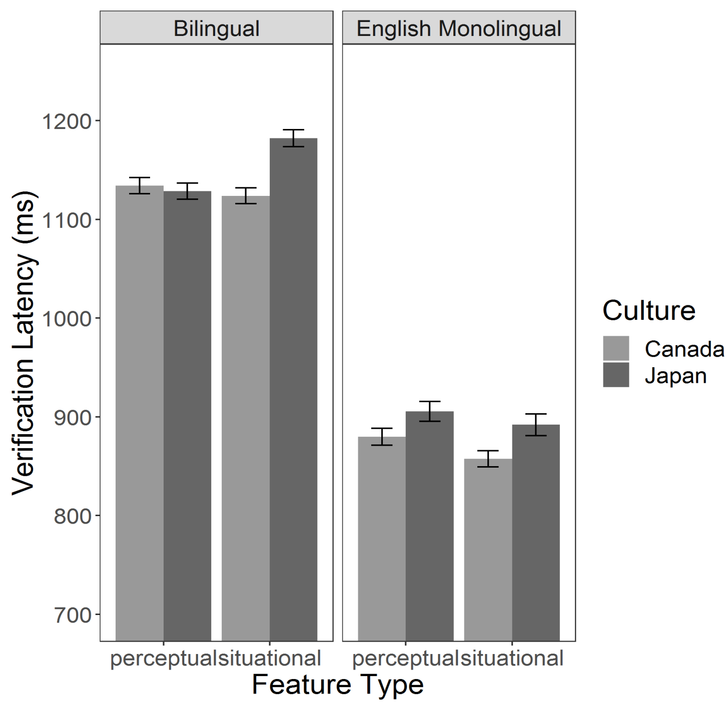

Figure 3. 9. Group comparisons of English feature verification latency.

Japanese Feature Verification Task

Verification rates. The model for Japanese feature verification rates is presented in Table 3.10. First, unlike the results for the English verification task, there was only a marginally significant main effect for Group ($\chi^2(1) = 3.07$, $p < .08$). There was a significant main effect for Culture Pair (χ^2 (1) = 16.39, p < .001), and most importantly, there was a significant Group x Culture Pair interaction (χ^2 (1) = 4.70, p < .05). Post hoc comparisons revealed that bilinguals' verification rates for pairs with Canadian-specific features were higher than Japanese monolinguals (t = -2.73, p < .01), while both groups had similar verification rates for pairs with Japanese-specific features (t = -0.45, p = .65) (See Figure 3.10). No other interaction was significant; Group x Feature Type (χ^2 (1) = 0.27, p = .60), Culture Pair x Feature Type (χ^2 (1) = 0.53, p = .47), and Group x Culture Pair x Feature Type (χ^2 (1) = 1.52, p = .22).

Table 3. 10. Model of Group Comparisons of Japanese Feature Verification Rates

Fixed-effects	*b*	*SE*	*z*	*p*
Intercept	2.08	0.10	21.89	p < .001
Group	-0.18	0.10	-1.75	p < .08
Culture	0.69	0.17	4.05	p < .001
Feature Type	0.01	0.17	0.08	*ns*
Group x Culture Pair	0.24	0.11	2.17	p < .05
Group x Feature Type	0.04	0.11	0.37	*ns*
Culture x Feature Type	0.12	0.34	0.36	*ns*
Group x Culture Pair x Feature Type	0.22	0.21	1.06	*ns*

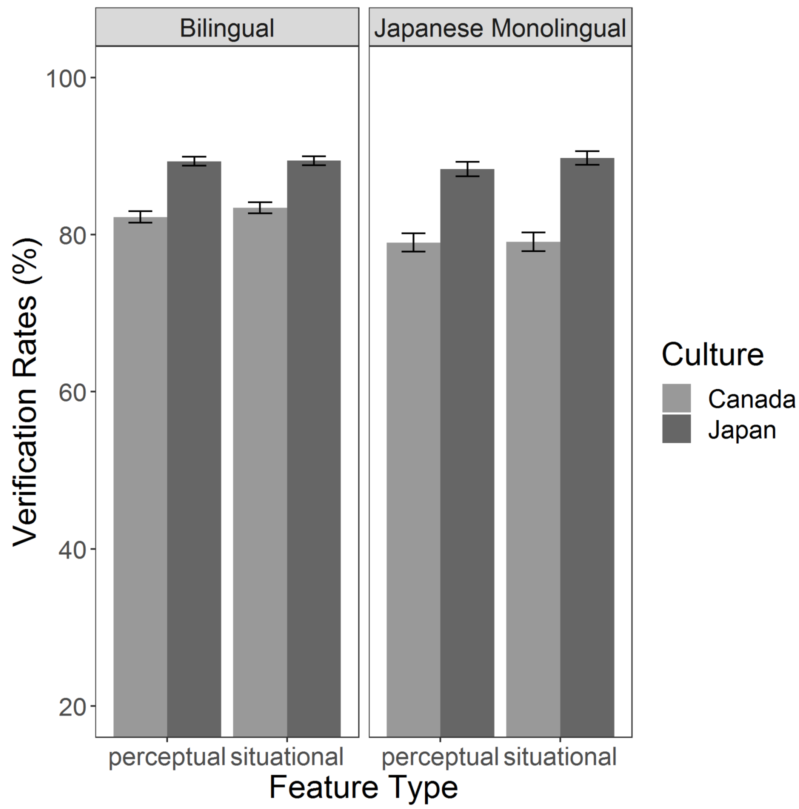

Figure 3. 10. Group comparisons of Japanese feature verification rates.

Verification latency. The NO responses (14.3% of the original data) and then RT outliers (the residuals greater than 2.5 standard deviation in absolute values; 1.6% of the original data) were removed from the analyses. The model for Japanese feature verification latency is presented in Table 3.11. There was a significant main effect for Culture Pair (χ^2 (1) = 4.18, $p < .05$) and a marginally significant main effect for Group (χ^2 (1) = 3.77, $p < .06$). As seen in Figure 3.11, both bilinguals and Japanese monolinguals responded to pairs with Japanese-specific features faster than to pairs with Canadian-specific features, and bilinguals responded relatively slower than Japanese monolinguals. No other main effect or interaction was significant: Feature Type (χ^2 (1) = 0.37, $p = .54$), Group x Culture Pair (χ^2 (1) = 1.32, $p = .22$), Group x Feature Type (χ^2 (1) = 0.53, $p = .47$), Culture Pair x Feature Type (χ^2 (1) = 1.13, $p = .29$), and Group x Culture Pair x Feature Type (χ^2 (1) = 0.57, $p = .45$).

Table 3. 11. Model of Group Comparisons of Japanese Feature Verification Latency

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	2.8917	0.0088	327.08	$p < .001$
Group	-0.0325	0.0168	-1.94	$p < .06$
Culture Pair	-0.0123	0.0060	-2.05	$p < .07$
Feature Type	0.0031	0.0061	0.51	*ns*
Group x Culture	-0.0047	0.0044	-1.07	*ns*
Group x Feature Type	0.0052	0.0045	1.16	*ns*
Culture x Feature Type	-0.0113	0.0120	-0.94	*ns*
Group x Culture Pair x Feature Type	0.0002	0.0087	0.03	*ns*

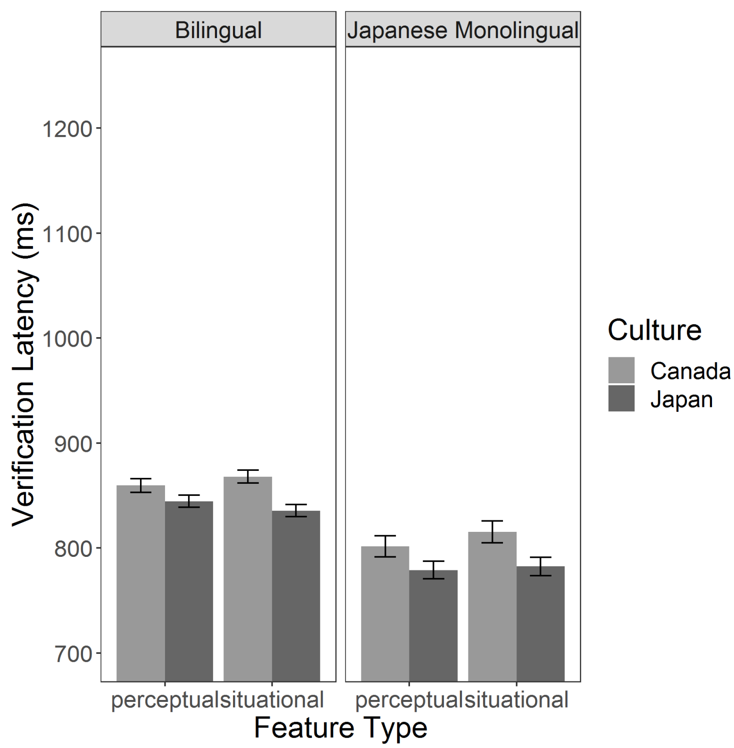

Figure 3. 11. Group comparisons of Japanese feature verification latency.

3.3.3.3 L1 vs L2 Task Comparisons within Bilinguals

Model. The goal of the analyses was to investigate whether bilinguals' feature verification rates and latencies depend on the language of the task (recall that they verified Canadian-specific and Japanese-specific features in both English and Japanese), and whether Language interacts with Culture Pair and Feature Type. Fixed factors included: Language (English vs. Japanese, sum coded), Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), and their interaction terms. Random factors included: subject (random intercept and random slope adjustment for Language, Culture, and Feature Type) and items (random intercept only).

Results

Verification rates. The model is presented in Table 3.12. First, there was a significant main effect for Language (χ^2 (1) = 176.05, p < .001). As seen in Figure 3.12, bilinguals' verification rates were higher when the task was in Japanese than when it was in English. There was no significant main effect for Culture Pair (χ^2 (1) = 1.20, p = .27) or Feature Type (χ^2 (1) = 0.07, p = .79). Most importantly, there was a significant Language x Culture interaction (χ^2 (1) = 109.93, p < .001). Post hoc comparisons revealed that bilinguals verified pairs with Canadian-specific features more often than pairs with Japanese-specific features when the task was in English (z = -1.90, p = .06), while they verified pairs with Japanese-specific features more often than pairs with Canadian-specific features when the task was in Japanese (z = 3.88, p < .001) (See Figure 3.10). No other interactions were significant.

Table 3. 12. Model of L1 vs L2 Comparisons for Feature Verification Rates

Fixed-effects	*b*	*SE*	*z*	*p*
Intercept	1.61	0.08	20.52	*p* < .001
Language	0.95	0.07	13.27	*p* < .001
Culture Pair	0.14	0.13	1.09	*ns*
Feature Type	-0.04	0.13	-0.27	*ns*
Language x Culture Pair	0.79	0.08	10.49	*p* < .001
Language x Feature Type	0.07	0.08	0.97	*ns*
Culture Pair x Feature Type	-0.07	0.26	-0.29	*ns*
Language x Culture Pair x Feature Type	0.01	0.15	0.10	*ns*

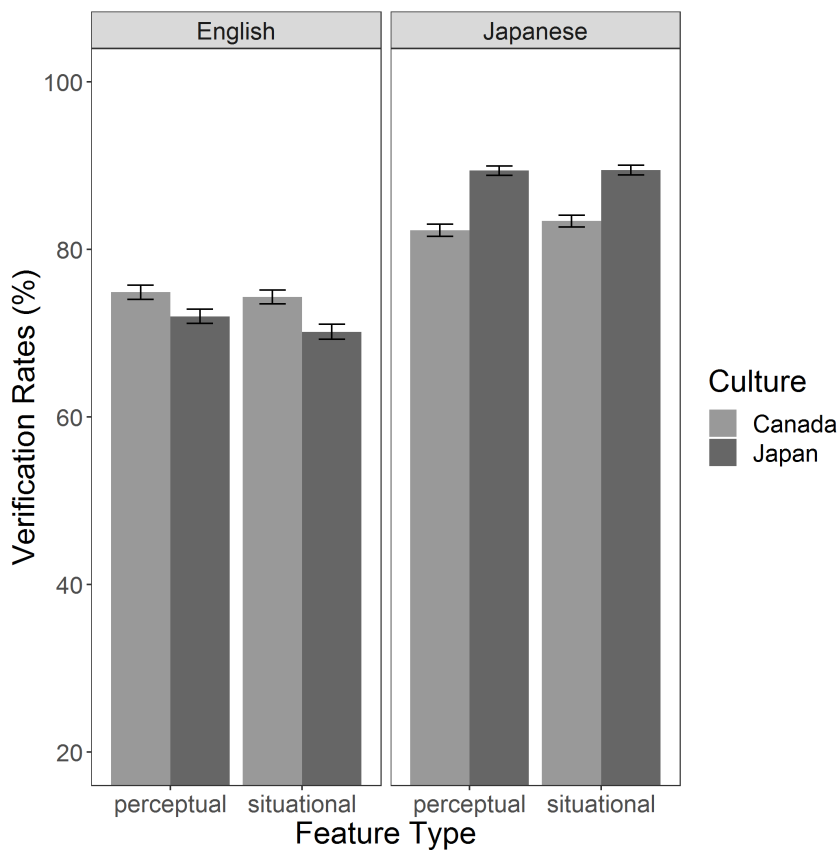

Figure 3. 12. L1 vs L2 comparisons for feature verification rates.

Verification latency. The model is presented in Table 3.13. First, there was a significant main effect for Language (χ^2 (1) = 5017.39, $p < .001$); verification latencies were faster when the task was performed in Japanese than in English. There was no significant main effect for Culture Pair (χ^2 (1) = 0.0005, *p* = .98) and Feature Type (χ^2 (1) = 0.73, *p* = .39). Most importantly, there was a significant Language x Culture Pair (χ^2 (1) = 37.97, *p* < .001) interaction. Responses to pairs with Canadian-specific features were faster than responses to pairs with Japanese-specific features when the task was in English, whereas responses to pairs with Japanese-specific features were faster than responses to pairs with Canadian-specific features when the task was in Japanese. The Language x Feature Type (χ^2 (1) = 10.33, *p* < .001) interaction was also significant but the Culture Pair x Feature Type interaction was not (χ^2 (1) = 0.38, *p* = .54). Furthermore, there was a significant Language x Culture Pair x Feature Type interaction (χ^2 (1) = 23.89, *p* < .001). Post hoc comparisons revealed that when the task was in English, pairs with Japanese-specific situational features had longer latencies than pairs with Canadian-specific situational features (*t* = 2.72, *p* < .01), whereas when the task was in Japanese, pairs with Canadian situational features had marginally longer latencies than pairs with Japanese situational features (*t* = -1.97, *p* = .05). There was no impact of Culture Pair on latencies for perceptual feature pairs in either language. (See Figure 3.13).

Table 3. 13. Model of L1 vs L2 Comparisons for Feature Verification Latency

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	-1.133	0.023	-50.05	*p* < .001
Language	-0.352	0.022	-16.25	*p* < .001
Culture Pair	-0.002	0.017	-0.12	*ns*
Feature Type	0.016	0.017	0.95	*ns*
Language x Culture Pair	-0.061	0.012	-5.13	*p* < .001
Language x Feature Type	-0.037	0.012	-3.09	*p* < .01
Culture x Feature Type	-0.001	0.033	-0.04	*ns*
Language x Culture Pair x Feature Type	-0.099	0.024	-4.13	*p* < .001

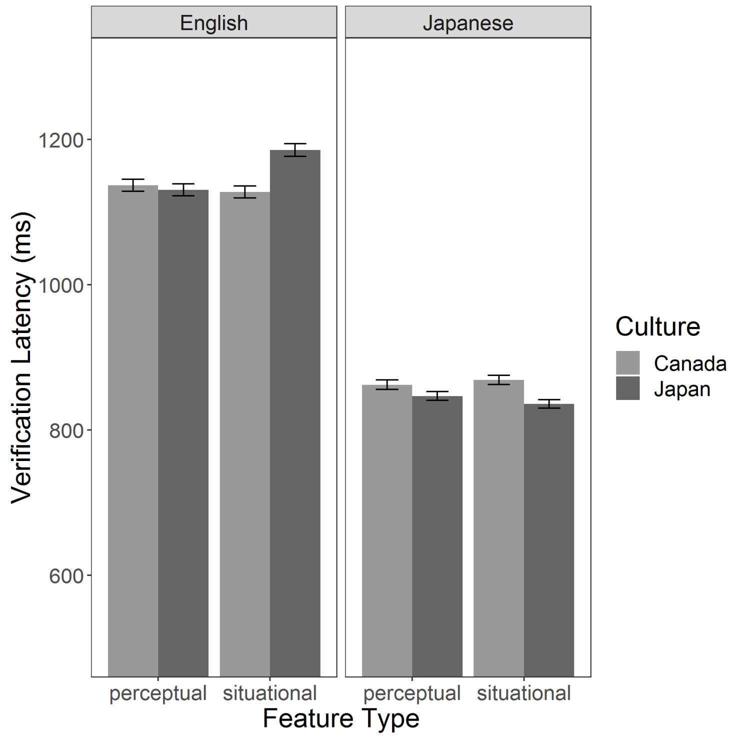

Figure 3. 13. L1 vs L2 comparisons for feature verification latency.

3.3.3.4 The Effects of Individual Differences

Model. The goal of the analyses was to find out whether individual differences (L2 Proficiency and Cultural Exposure) have any influence on bilinguals' feature verification rates and latency. I started the analyses with a baseline model (Model 0) that included the main effects of the four fixed factors: Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), L2 Proficiency (continuous; scaled), and L2 Cultural Exposure (continuous; scaled). For random effects, I included intercepts for subjects and items, as well as the by-subject random slope for the Culture Pair and the by-item random slope for the effect of L2 Cultural Exposure. To examine whether the interaction between Culture Pair and each of the other three fixed variables improved the model fit, I performed a series of model comparisons using the likelihood ratio test by incrementally adding the interaction terms to the baseline model. In reporting the results for each task, the first paragraph describes the process of determining the model that provides the best fit, and the next paragraph describes the nature of the effects in the final model.

English (L2) Task

Verification rates data. The baseline model is shown in Table 3.14. First, the addition of the Culture Pair x Feature Type interaction to the baseline model did not significantly improve the model fit (Model 3; χ^2 (1) = 0.73, p = .39). However, the addition of the Culture Pair x L2 Proficiency interaction to the baseline model significantly improved the model fit (Model 1; χ^2 (1) = 8.50, $p < .01$). The addition of the Culture Pair x Culture Exposure interaction to the baseline model also significantly improved the model fit (Model 2; χ^2 (1) = 13.32, $p < .001$). Furthermore, the model with both the Culture Pair x L2 Proficiency interaction and the Culture Exposure x Culture Pair interaction (Model 4) had a significantly better fit compared to Model 2 (Model 4; χ^2 (1) = 16.52, $p < .001$) and Model 3 (Model 4; χ^2 (1) = 8.76, $p < .01$).

Based on the model selection process above, Model 4 has the best fit (see Table 3.14). The model consists of the main effects of the four variables (Culture Pair, Feature Type, L2 Proficiency, and Cultural Exposure), as well as the Culture Pair x L2 Proficiency and the Culture Pair x Culture Exposure interactions. In this model, there was a marginally significant main effect of Cultural Pair (χ^2 (1) = 3.65, p = .06), with a higher rate of verification for pairs with Canadian-specific features than pairs with Japanese-specific features. There were also significant main effects for L2 Proficiency (χ^2 (1) = 4.64, $p < .05$) and L2 Cultural Exposure (χ^2 (1) = 8.94, $p < .01$), with higher rates of verification with more L2 Proficiency and with more L2 Cultural Exposure. More importantly, the Culture Pair x L2 Proficiency interaction was significant (χ^2 (1) = 3.97, $p < .05$). Post hoc comparisons revealed that more L2 Proficiency lead to higher verification rates for pairs with Canadian-specific features (z = 2.69, $p < .01$) but not for pairs with Japanese-specific features (z = 1.25, p = .21) (see Figure 3.14). There was also a significant Culture Pair x L2 Culture Exposure interaction (χ^2 (1) = 9.20, $p < .01$), indicating that more Cultural Exposure lead to higher verification rates for pairs with Canadian-specific features (z = 3.92, $p < .001$) but not for pairs with Japanese-specific features (z = 1.36, p = .17) (See Figure 3.15).

Similar to the analyses conducted for typicality ratings, the results above were further investigated to check the influence of collinearity between L2 Proficiency and

Cultural Exposure. Fixed factors included: Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), L2 Proficiency (continuous), and their interaction term. Random factors included: subject (random intercept and random slope adjustment for Culture Pair) and items (random intercept and random slope adjustment for L2 Proficiency). As seen in Figure 3.16, there was no longer a significant Culture Pair x L2 Proficiency interaction (χ^2 (1) = 0.14 p = .71), which implies that the interaction effect visible in Model 4 above is probably largely due to the Cultural Exposure factor. Taken together, the results suggest that Cultural Exposure, but not L2 Proficiency, is likely to differentially impact the verification rates for the two types of Culture Pairs.

Verification latency data. The latency data are only based on verified responses; 25.8% of the original trials were excluded from the analyses because they received "NO" responses. The baseline model is shown in Table 3.15. First, neither the addition of the Culture Pair x Feature Type interaction (Model 1; χ^2 (1) = 1.86, p = .17) nor the addition of the Culture Pair x L2 Proficiency interaction (Model 2; χ^2 (1) = 0.70, p = .40) significantly improved the fit of the model. However, the addition of the Culture Pair x L2 Culture Exposure interaction to the baseline model significantly improved the model fit (Model 3; χ^2 (1) = 6.21, $p < .05$).

Based on the model selection process above, Model 3 has the best fit (see Table 3.15). The model consists of the main effects of the four variables (Culture Pair, Feature Type, L2 Proficiency, and L2 Cultural Exposure) and the Culture Pair x L2 Cultural Exposure interaction. In this model, there was a significant Culture Pair x L2 Cultural Exposure interaction effect (χ^2 (1) = 2.34, $p < .05$). As L2 Cultural Exposure increases, response times for pairs with Canadian-specific features become faster but response times do not change for pairs with Japanese-specific features (See Figure 3.17). As seen in the analyses in verification rates above, the results of further analyses with bilinguals with no L2 Cultural Exposure confirmed that there is no Culture Pair x L2 Proficiency interaction (χ^2 (1) = 0.39, p = .53), indicating that the L2 Cultural Exposure is likely to be the factor causing the interaction with Culture Pair.

Table 3. 14. Baseline (Model 0) and Best Fit (Model 4) Models for Verification Rates in the English Feature Verification Task

	Model 0				Model 4			
Fixed-effects	*b*	*SE*	*z*	*p*	*b*	*SE*	*z*	*p*
Intercept	1.14	0.08	13.49	$p < .001$	1.15	0.08	13.53	$p < .001$
Culture Pair	-0.37	0.14	-2.61	$p < .01$	-0.26	0.14	-1.90	$p = .06$
L2 Proficiency	0.12	0.06	2.00	$p < .05$	0.13	0.06	2.16	$p < .05$
Culture Exposure	0.18	0.07	2.76	$p < .05$	0.19	0.06	2.99	$p < .05$
Feature Type	-0.08	0.13	-0.60	*ns*	-0.08	0.13	-0.60	*ns*
Culture Pair x L2 Proficiency	-	-	-	-	-0.10	0.05	-1.99	$p < .05$
Culture Pair x Culture Exp	-	-	-	-	-0.19	0.06	-3.03	$p < .05$

Table 3. 15. Baseline (Model 0) and Best Fit (Model 3) Models for Verification Latency in the English Feature Verification Task

	Model 0				Model 3			
Fixed-effects	*b*	*SE*	*t*	*p*	*b*	*SE*	*t*	*p*
Intercept	-0.952	0.021	-44.77	$p < .001$	-0.952	0.021	-44.81	$p < .001$
Culture Pair	0.039	0.021	1.86	$p = .07$	0.023	0.022	1.05	*ns*
L2 Proficiency	-0.032	0.020	-1.58	*ns*	-0.032	0.020	-1.58	*ns*
Culture Exposure	0.014	0.020	0.68	*ns*	0.007	0.021	0.36	*ns*
Feature Type	0.023	0.020	1.14	*ns*	0.023	0.020	0.25	*ns*
Culture Pair x Culture Exposure	-	-	-	-	0.019	0.009	2.11	$p < .05$

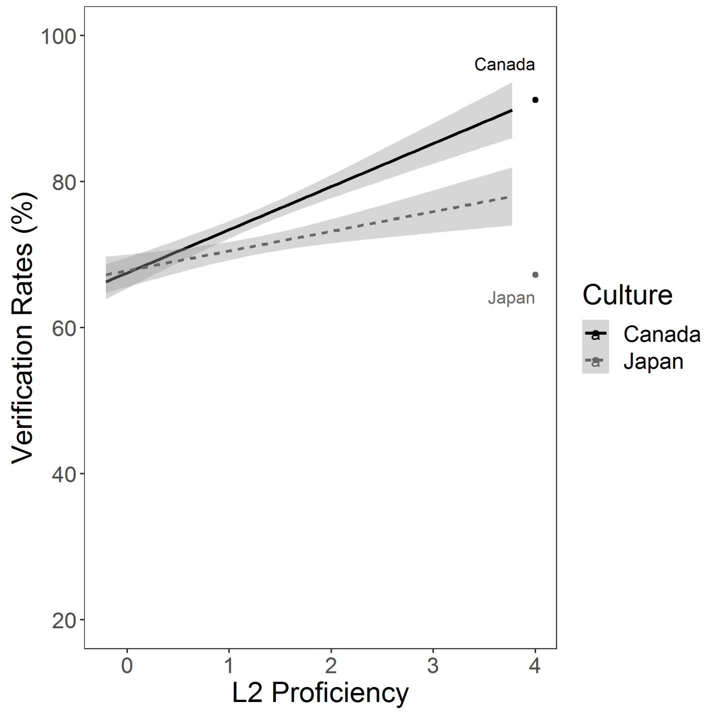

Figure 3. 14. Effect of L2 Proficiency (in d') on verification rates in the English feature verification task. The dots indicate the mean verification rates for monolingual English participants.

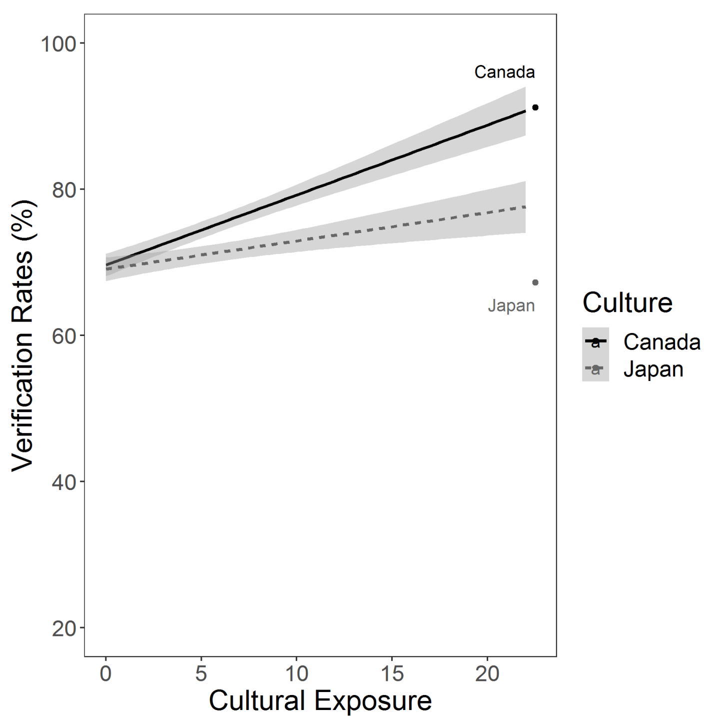

Figure 3. 15. Effect of L2 Cultural Exposure (in years) on verification rates in the English feature verification task. The dots indicate the mean verification rates for monolingual English participants.

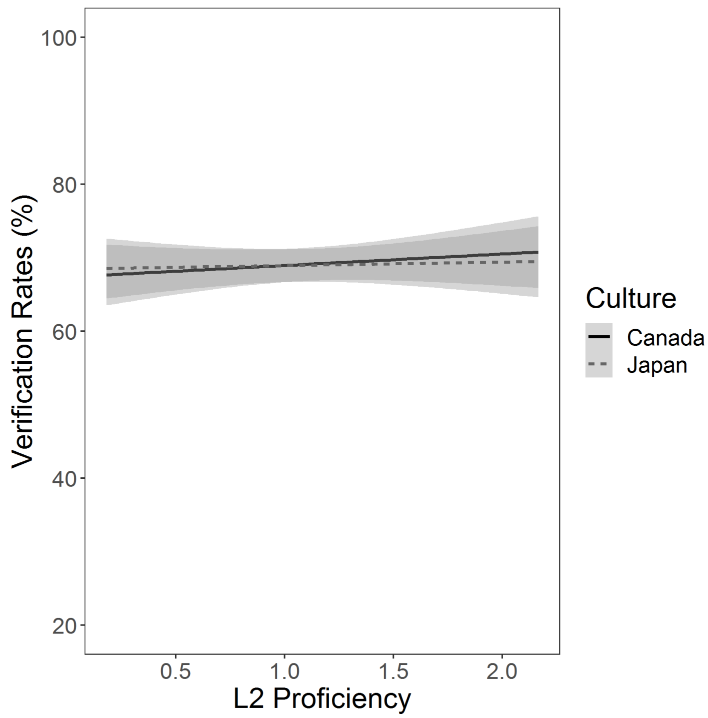

Figure 3. 16. The absence of a Culture Pair (Canadian vs Japanese pairs) x L2 Proficiency interaction effect on English feature verification rates for bilinguals with no L2 Cultural Exposure.

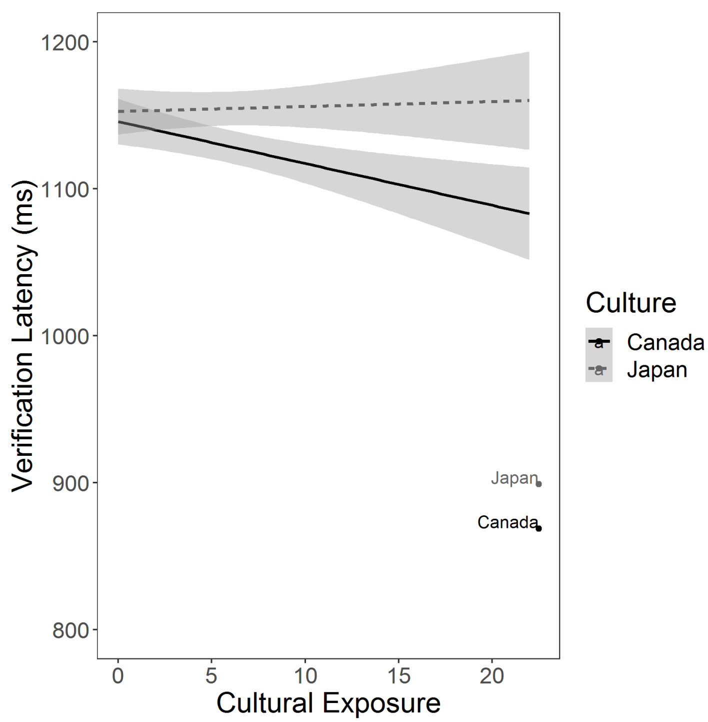

Figure 3. 17. Effect of L2 Cultural Exposure (in years) on verification latency in the English feature verification task. The dots indicate the mean verification latency for monolingual English participants.

Japanese (L1) Task

Verification rates data. The results of the model selection for the Japanese feature verification task were similar to those found for the English task. The baseline model is shown in Table 3.16. First, the addition of the Culture Pair x Feature Type interaction to the baseline model did not significantly improve the model fit (Model 1; χ^2 (1) = 0.01, p = .90). Second, the addition of the Culture Pair x L2 Proficiency interaction to the baseline model significantly improved the model fit (Model 2; χ^2 (1) = 8.96, p < .01). Third, the addition of the Culture Pair x L2 Culture Exposure interaction to the baseline model also significantly improved the model fit (Model 3; χ^2 (1) = 8.17, p < .01). Furthermore, the model with both the Culture Pair x L2 Proficiency interaction and the Culture Pair x L2 Culture Exposure interaction (Model 4) had a significantly better fit compared to Model 2 (Model 4; χ^2 (1) = 12.57, p < .001) and was marginally significant in comparison with Model 3 (Model 4; χ^2 (1) = 3.62, p = .06).

Based on the model selection process above, Model 4 (see Table 3.16) has the best fit. The model consists of the main effects of the four variables (Culture Pair, Feature Type, L2 Proficiency, L2 Cultural Exposure), the Culture Pair x L2 Proficiency interaction, and the Culture Pair x Culture Exposure interaction. In this model, there was a significant main effect of Cultural Pair (χ^2 (1) = 10.81, p < .01), with a higher rate of verification for pairs with Japanese-specific features than for pairs with Canadian-specific features. More importantly, the Culture Pair x L2 Proficiency interaction was significant (χ^2 (1) = 4.61, p < .05). With more L2 Proficiency, the verification rate for pairs with Canadian-specific features increases while it slightly declines for pairs with Japanese-specific features (See Figure 3.18). Furthermore, there was a marginally significant Culture Pair x L2 Culture Exposure interaction (χ^2 (1) = 3.78, p < .06). More L2 Cultural Exposure leads to a higher verification rate for pairs with Canadian-specific features (z = 1.88, p < .06) but not for pairs with Japanese-specific features (See Figure 3.19).

Although the analyses above indicate the presence of two interactions (i.e., Culture Pair x L2 Proficiency and Culture Pair x Cultural Exposure), further analyses revealed that the Culture Pair x L2 Proficiency interaction no longer exists (χ^2 (1) = 0.07, p = .78) when the Culture Exposure factor is controlled by only analyzing bilinguals with no L2 Cultural Exposure (See Figure 3.20). This indicates that the results above suffered from collinearity between L2 Proficiency and L2 Cultural Exposure, and L2 Cultural Exposure is more likely to differentially impact the verification rates for the two types of Culture Pairs.

Verification latency data. The latency data are only based on verified responses; 13.76% of the original trials were excluded from the analyses. The baseline model is shown in Table 3.17. The addition of the interactions of interest did not improve model fit compared to the baseline model: Culture Pair x Feature Type (Model 1; χ^2 (1) = 1.79, p = .18), Culture Pair x L2 Proficiency (Model 2; χ^2 (1) = 0.12, p = .72), Culture Pair x L2 Cultural Exposure (Model 3; χ^2 (3) = 0.15, p = .70).

Table 3. 16. Baseline (Model 0) and Best Fit (Model 4) Models for Verification Rates in the Japanese Feature Verification Task

	Model 0				Model 4			
Fixed-effects	*b*	*SE*	*z*	*p*	*b*	*SE*	*z*	*p*
Intercept	2.17	0.01	21.95	$p < .001$	2.17	0.10	21.95	$p < .001$
Culture Pair	0.48	0.18	2.76	$p < .01$	0.56	0.17	3.29	$p < .01$
L2 Proficiency	-0.01	0.06	-0.12	*ns*	-0.02	0.06	-0.29	*ns*
Culture Exposure	0.08	0.07	1.15	*ns*	0.07	0.07	1.10	*ns*
Feature Type	0.06	0.17	0.69	*ns*	0.07	0.17	0.40	*ns*
Culture Pair x L2 Proficiency	-	-	-	-	-0.14	0.07	-2.15	$p < .05$
Culture Pair x Culture Exposure	-	-	-	-	-0.14	0.07	-1.94	$p = .05$

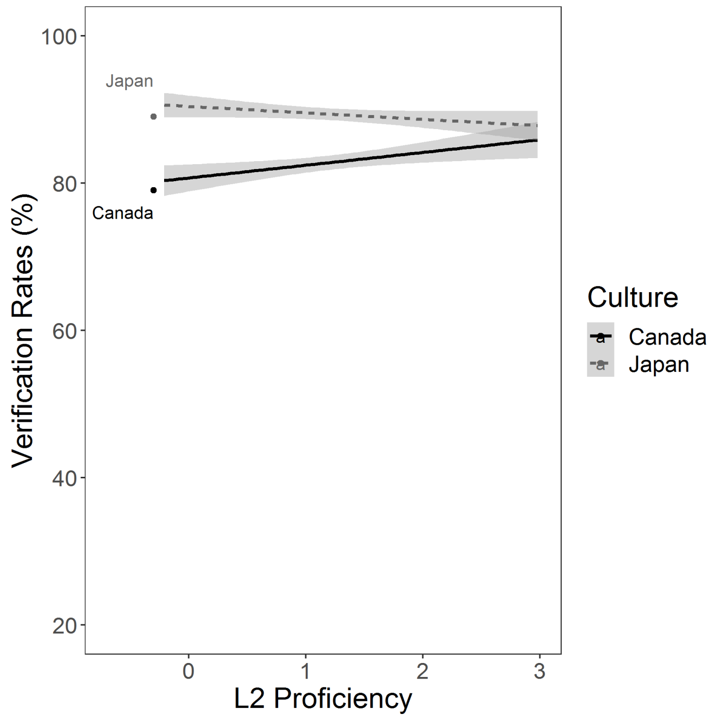

Figure 3. 18. The effect of L2 Proficiency (in d') on verification rates in the Japanese feature verification task. The dots indicate the mean verification rate for monolingual Japanese participants.

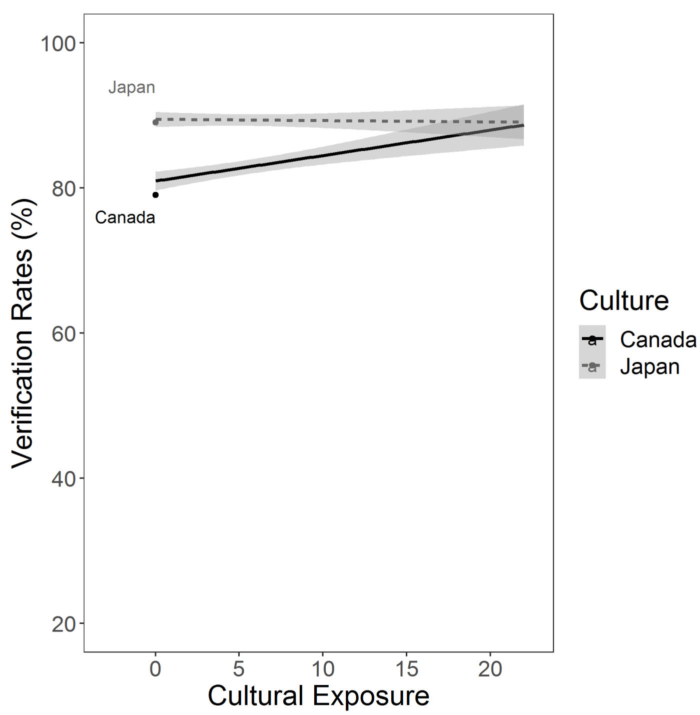

Figure 3. 19. The effect of Cultural Exposure (in years) on verification rates in the Japanese feature verification task. The dots indicate the mean verification rate for monolingual Japanese participants.

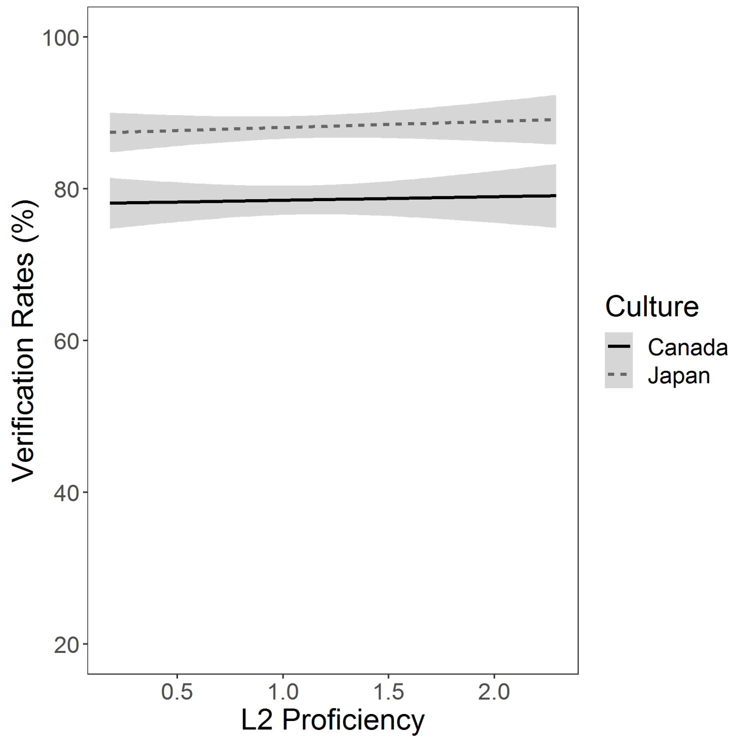

Figure 3. 20. The absence of a Culture Pair (Canadian vs Japanese pairs) x L2 Proficiency interaction effect on Japanese feature verification rates for bilinguals with no L2 Cultural Exposure.

Table 3. 17. Baseline (Model 0) for Verification Latency in the Japanese Feature Verification Task

	Model 0			
Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	-1.3127	0.0272	-48.24	$p < .001$
Culture Pair	-0.0290	0.0188	-1.55	*ns*
L2 Proficiency	-0.0190	0.0282	-0.67	*ns*
Culture Exposure	0.1043	0.0282	3.70	$p < .001$
Feature Type	0.0004	0.0187	0.02	*ns*

3.3.4 Summary

The bilinguals differed from monolinguals most clearly in their verification rates for Canadian cultural pairs. When the task was in English, bilinguals' verification rates for pairs with Canadian-specific features were substantially lower compared to English monolinguals, whereas when the task was in in Japanese, bilinguals verified pairs with Canadian-specific features more often compared to Japanese monolinguals. In contrast, the bilinguals' verification rates for pairs with Japanese-specific features were significantly higher than for English monolinguals, but surprisingly, the difference just reached significance, and it did not differ from the rate for Japanese monolinguals. These findings demonstrate that the bilinguals exhibited semantic accents in both L1 and L2 due to their knowledge of English, while their L1 word and feature links appeared to remain constant. Comparisons of bilinguals and monolinguals in the latency analyses produced less interesting results. The interpretation of the English latency data is complicated by the large difference in response times between bilinguals and monolinguals, and the bilinguals did not produce a different pattern of results from Japanese monolinguals in the Japanese latency data. As was seen in typicality rating task, bilinguals responded to the same items differently depending on the language of the words. More specifically, bilinguals on average verified pairs with Canadian-specific features more often and faster than pairs with Japanese-specific when the task was in English, whereas they verified pairs with Japanese-specific features more often and faster than pairs with Canadian-specific features when the task was in Japanese. Thus, L1 and L2 conceptual asymmetry, which was predicted in the SDA model, was also observed in feature verification rates. In the response latency data, this finding was specific to situational feature pairs. Finally, L2 cultural exposure had a greater influence on bilinguals' verification rates and latency than L2 proficiency, although these results were specific to Canadian cultural pairs. Overall, the results from feature verification task indicate that although semantic accents are observed in both L1 and L2, the links between L1 word and L1 features remained similar, indicating that not all culture-specific features are susceptible to change in a speeded task.

3.4 Experiment 3: Lexical Decision Task with Semantic Priming

3.4.1 Introduction

In Experiment 3, I conducted a semantic priming task with lexical decision. The purpose of this experiment was to explore whether semantic accents involve automatic processing. In the first two experiments, which involved a feature typicality rating task and a feature verification task, the participants were asked to actively seek for a possible relationship between a word and a feature. This experiment, on the other hand, addresses the issue as to whether semantic accents are still observed without participants' conscious judgment. On each trial of the task, participants first saw a feature (e.g., yellow) as a prime followed by a word (e.g., BUS) as a target. They were asked to make a lexical decision on the targets. The performance on related trials was compared to performance on unrelated trials (e.g., stone – BUS). The size of the semantic priming effect is an indication of the connection strength between a word and a feature.

Evidence for a semantic accent in their L2 would be obtained if bilinguals produce a larger priming effect for pairs with Japanese-specific features and/or a smaller priming effect for pairs with pairs with Canadian-specific features compared to English monolinguals. Similarly, evidence for a semantic accent in L1 would be found if bilinguals produce a larger priming effect for pairs with Canadian-specific features and/or a smaller priming effect for pairs with Japanese-specific features compared to Japanese monolinguals. Furthermore, if bilinguals exhibit conceptual asymmetry, they should produce a larger priming effect for pairs with Canadian-specific features when the task is in English (L2) than in Japanese (L1), and a larger priming effect for pairs with Japanese-specific features when the task is in Japanese than in English. Finally, if the word-feature connections change depending on individual differences, bilinguals may produce larger priming effects for pairs with Canadian-specific features and smaller priming effects for pairs with Japanese-specific features with more L2 proficiency and/or years of residence in an L2 speaking country.

3.4.2 Method

3.4.2.1 Participants

The participants were identical to Experiment 1.

3.4.2.2 Stimuli

Critical stimuli were the 120 word and feature pairs that were used in Experiments 1 and 2. Words (e.g., BALLOON) were used as targets and shortened forms of the features (e.g., "used at birthday parties" to "birthday") were used as primes. Each word was paired either with a related (e.g., birthday) or unrelated (e.g., hotel) feature. In order to create two counterbalanced lists, the stimuli were first divided into two sets. Each set had an equal number of items with Canadian and Japanese specific features, and half of each of these had perceptual features and half had situational features. Unrelated control pairs were created by repairing each word with another feature from the same set. List 1 had related trials from the first set and unrelated trials from the second set and List 2 had the reverse. Each participant received one of the two lists.

An additional 120 pairs of prime words and nonword targets were used to create "NO" response filler trials (there were no "YES" filler trials). Since the target words mostly consisted of concrete objects and places (there is one exception; "graduation ceremony"), the prime words for nonword targets were chosen accordingly. The English-like nonwords were selected from the English Lexicon Project database (Balota et al., 2007) and the Japanese-like nonwords were created by changing the order of or substituting the characters of real words (e.g., "システム" to "シスムテ", "水蒸気" to "水蒸木". Both the primes and their nonword targets were matched in length to the primes and targets used for the critical trials. Mean word length for the stimuli used in the lexical decision task is summarized in Table 3.18.

Table 3. 18. Mean Word Length of Stimuli for Lexical Decision Task (*SD* in brackets)

English		Japanese	
Target	Prime	Target	Prime
6.69 (2.67)	7.19 (3.43)	2.79 (1.45)	2.85 (1.73)

3.4.2.3 Procedure

For the lexical decision task, the words were presented as the targets (e.g., “BUS”) and the features appeared as the primes (e.g., “yellow). Participants were asked to decide whether a target word was a real word or not. First, a fixation point was presented for 500 ms, followed by a 200 ms presentation of the prime. Finally, the target was presented for 1500 ms or until the participant responded. All participants did 10 practice trials before they started the experimental task. The task took 10 minutes to complete. The task was programmed using the DMDX software package (Forster & Forster, 2003).

3.4.3 Results

3.4.3.1 Analysis Procedure

Error data were analyzed using generalized linear mixed models (due to the binary nature of the response) and reaction time data (log transformation was used instead of raw reaction times) were analyzed using linear mixed models. The relevant fixed factors were included for each analysis and random intercepts for subjects and items were included for all models. Random slopes were determined by comparisons of models with different random slopes. Omnibus tests were carried out to find any significant main effects and interactions. Words for which a participant did not give a typicality rating were assumed to be unknown to the participant, and the data from those items were not included in the analyses. Consequently, 4.5 % of responses in English task and 0.9% of responses in Japanese tasks from bilinguals’ data were removed from the following analyses. Mean reaction times and error rates in all conditions are summarized in Appendix I (English task) and J (Japanese task).

3.4.3.2 Comparisons between Bilinguals and Monolinguals

Model. The goal of the analyses was to find out whether there were any differences between bilinguals and monolinguals on lexical decision task performance and whether the group of participants interacts with Culture Pair and Feature Type. Fixed factors included: Relation (Related vs. Japanese, sum coded), Group (Monolingual vs. Bilingual; sum coded), Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), and their interaction terms. Random factors included: subject (random intercept and random slope adjustment for Culture and Feature Type) and items (random intercept only).

English Lexical Decision Task

Error data. The model is presented in Table 3.19. First, there was a significant main effect for Relation (χ^2 (1) = 19.88, $p < .001$). Furthermore, there was a significant Relation x Group interaction (χ^2 (1) = 4.10, $p < .05$), but the Relation x Culture Pair (χ^2 (1) = 2.53, $p = .11$) and the Relation x Feature Type (χ^2 (1) = 0.20, $p = .65$) interactions were not significant. Most importantly, there was a significant Relation x Group x Culture interaction (χ^2 (1) = 4.54, $p < .05$) (See Figure 3.21). Post hoc analyses revealed that, for pairs with Japanese-specific features, bilinguals produced a significant facilitatory priming effect (t = -2.28, $p < .05$) whereas English monolinguals did not (t = -1.25, p = 0.21). For pairs with Canadian-specific features, on the other hand, bilinguals only produced a marginal priming effect (t = -1.63, p = 0.10) whereas English monolinguals produced a significant priming effect (t = 3.60, $p < .05$). No other interactions of interest were significant. See Appendix I for the exact mean values.

Table 3. 19. Model of Group Comparisons for Errors in English Lexical Decision

Fixed-effects	*b*	*SE*	*z*	*p*
Intercept	3.68	0.17	22.20	$p < .001$
Relation	-0.36	0.08	-4.46	$p < .001$
Group	1.41	0.22	6.47	$p < .001$
Culture Pair	-0.38	0.28	-1.35	*ns*
Feature Type	-0.53	0.28	-1.90	.06
Relation x Group	-0.33	0.16	-2.03	$p < .05$
Relation x Culture Pair	0.26	0.16	1.59	*ns*
Group x Culture Pair	-1.42	0.26	-5.55	$p < .001$
Relation x Feature Type	0.07	0.16	0.45	*ns*
Group x Feature Type	0.46	0.25	1.84	$p < .07$
Culture Pair x Feature Type	-0.32	0.54	-0.59	*ns*
Relation x Group x Culture Pair	0.68	0.32	2.13	$p < .05$
Relation x Group x Feature Type	0.10	0.32	0.31	*ns*
Relation x Culture Pair x Feature Type	-0.11	0.32	-0.36	*ns*
Group x Culture Pair x Feature Type	0.48	0.49	0.97	$p < .05$
Relation x Group x Culture Pair x Type	-0.59	0.64	-0.92	*ns*

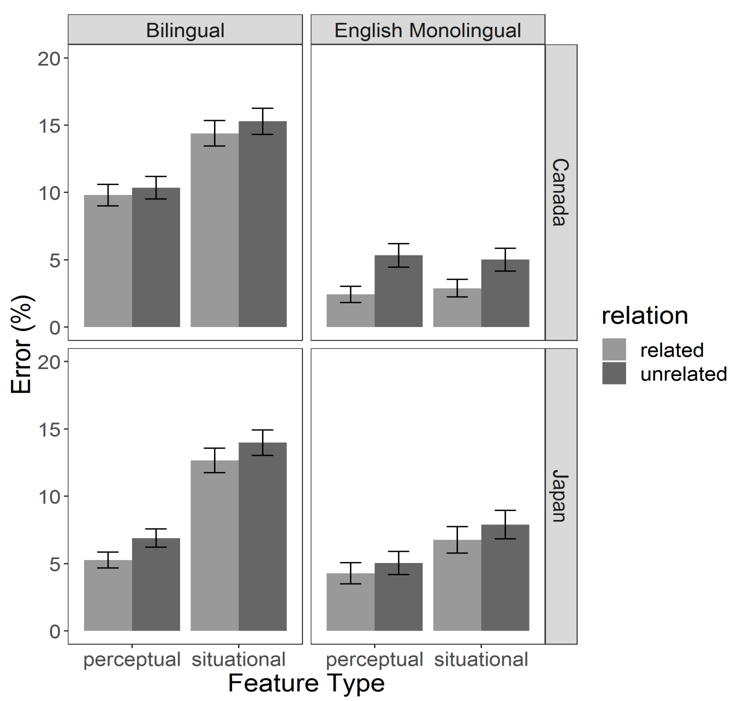

Figure 3. 21. Group comparison for error rates in English lexical decision. Means for pairs with Canadian-specific features are on top and for pairs with Japanese-specific features are on the bottom.

Reaction time data. The model is presented in Table 3.20. There was a significant effect for Relation (χ^2 (1) = 37.02, $p < .001$). As seen in Figure 3.22, related pairs were responded faster than unrelated pairs and this difference was somewhat more evident for pairs with Canadian-specific features than for pairs with Japanese-specific features. No other interactions of interest were significant. See Appendix I for the exact mean values.

Table 3. 20. Model of Group Comparisons for Reaction Time in English Lexical Decision

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	-1.411	0.0267	-52.74	$p < .001$
Relation	0.030	0.0046	6.40	$p < .001$
Group	-0.398	0.0046	-9.38	$p < .001$
Culture	0.025	0.033	0.77	*ns*
Feature Type	0.079	0.033	2.36	$p < .05$
Relation x Group	0.009	0.009	1.00	*ns*
Relation x Culture Pair	-0.015	0.009	-1.65	$p = .10$
Group x Culture Pair	0.056	0.013	4.22	$p < .001$
Relation x Feature Type	-0.001	0.009	-0.15	*ns*
Group x Feature Type	-0.069	0.013	-5.20	$p < .001$
Culture Pair x Feature Type	0.090	0.067	-5.20	*ns*
Relation x Group x Culture Pair	-0.005	0.019	-0.26	*ns*
Relation x Group x Feature Type	0.031	0.019	1.65	*ns*
Relation x Culture Pair x Feature Type	-0.005	0.019	-0.29	*ns*
Group x Culture Pair x Feature Type	-0.028	0.026	-1.05	*ns*
Relation x Group x Culture Pair x Feature Type	0.021	0.037	0.56	*ns*

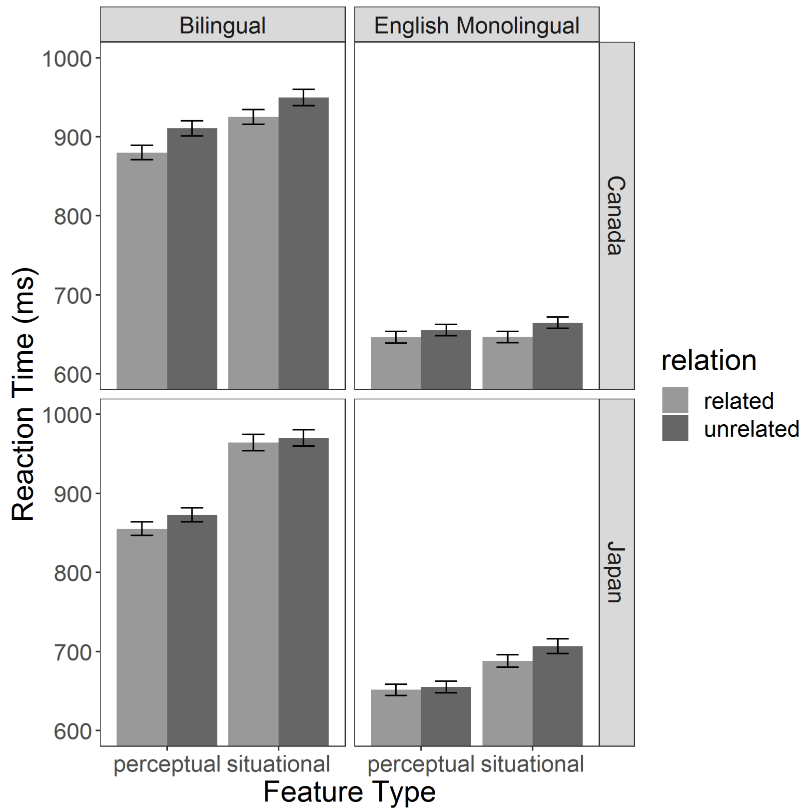

Figure 3. 22. Group comparisons for reaction time in English lexical decision.

Japanese Lexical Decision Task

Error data. The model is presented in Table 3.21. First, there was a significant main effect for Relation (χ^2 (1) = 11.35, $p < .001$). There was a significant Relation x Group interaction (χ^2 (1) = 6.45, $p < .05$). Post hoc analysis revealed that bilinguals did not produce a significant priming effect ($t = -0.81$, $p = .42$) but Japanese monolinguals did ($t = -3.45$, $p < .001$) (See Figure 3.23). No other interactions of interest were significant. See Appendix J for the exact mean values.

Table 3. 21. Model of Group Comparisons for Errors in Japanese Lexical Decision

Fixed-effects	*b*	*SE*	*z*	*p*
Intercept	4.188	0.152	27.487	$p < .001$
Relation	-0.324	0.096	-3.371	$p < .001$
Group	0.295	0.205	1.439	*ns*
Culture Pair	0.088	0.265	0.333	*ns*
Feature Type	-0.083	0.265	-0.312	*ns*
Relation x Group	-0.488	0.192	-2.540	$p < .05$
Relation x Culture Pair	0.063	0.192	0.330	*ns*
Group x Culture Pair	-0.081	0.296	-0.274	*ns*
Relation x Feature Type	-0.099	0.191	-0.517	*ns*
Group x Feature Type	0.388	0.296	1.312	*ns*
Culture Pair x Feature Type	-0.001	0.516	-0.002	*ns*
Relation x Group x Culture Pair	0.380	0.383	0.991	*ns*
Relation x Group x Feature Type	-0.191	0.381	-0.501	*ns*
Relation x Culture Pair x Feature Type	-0.342	0.381	-0.896	*ns*
Group x Culture Pair x Feature Type	-0.431	0.583	-0.739	*ns*
Relation x Group x Culture Pair x Type	-0.003	0.762	-0.004	*ns*

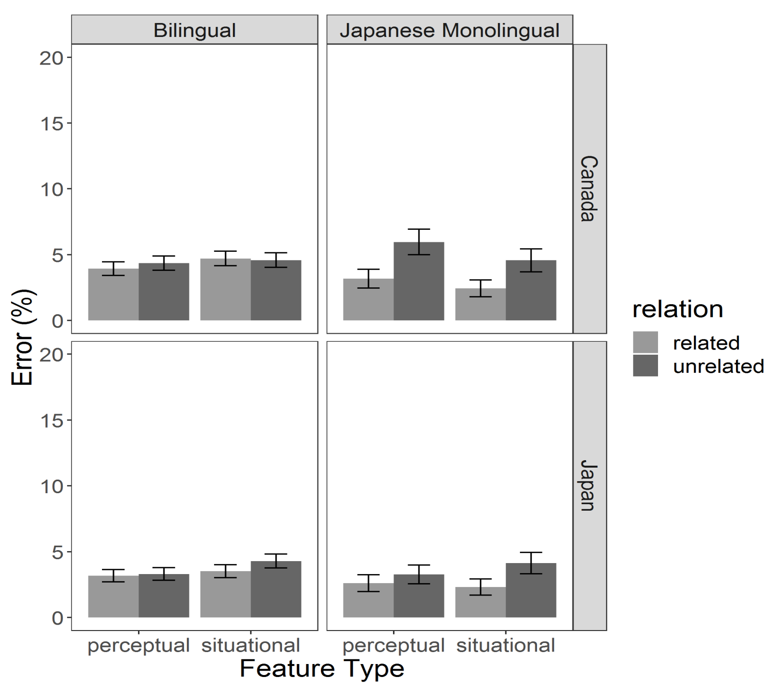

Figure 3. 23. Group comparisons for error rates in Japanese lexical decision.

Reaction time data. The model is presented in Table 3.22. There was a significant main effect for Relation (χ^2 (1) = 17.30, $p < .001$), indicating that related pairs were generally responded faster than unrelated pairs (see Figure 3.24). No interactions of interest were significant. See Appendix J for the exact mean values.

Table 3. 22. Model of Group Comparisons for Reaction Time in Japanese Lexical Decision

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	-1.6389	0.0312	-52.54	$p < .001$
Relation	0.0242	0.0054	4.52	$p < .001$
Group	-0.0988	0.0567	-1.75	*ns*
Culture Pair	-0.0608	0.0272	-2.23	$p < .05$
Feature Type	0.0636	0.0274	2.32	$p < .05$
Relation x Group	0.0006	0.0107	0.05	*ns*
Relation x Culture Pair	0.0248	0.0107	2.32	$p < .05$
Group x Culture Pair	0.0134	0.0154	0.87	*ns*
Relation x Feature Type	0.0201	0.0107	1.88	$p = .06$
Group x Feature Type	0.0060	0.0165	0.36	*ns*
Culture Pair x Feature Type	-0.0319	0.0544	-0.59	*ns*
Relation x Group x Culture Pair	-0.0045	0.0214	-0.21	*ns*
Relation x Group x Feature Type	-0.0199	0.0214	-0.93	*ns*
Relation x Culture Pair x Feature Type	-0.0093	0.0214	-0.43	*ns*
Group x Culture Pair x Feature Type	0.0067	0.0301	0.22	*ns*
Relation x Group x Culture Pair x Type	0.0190	0.0428	0.44	*ns*

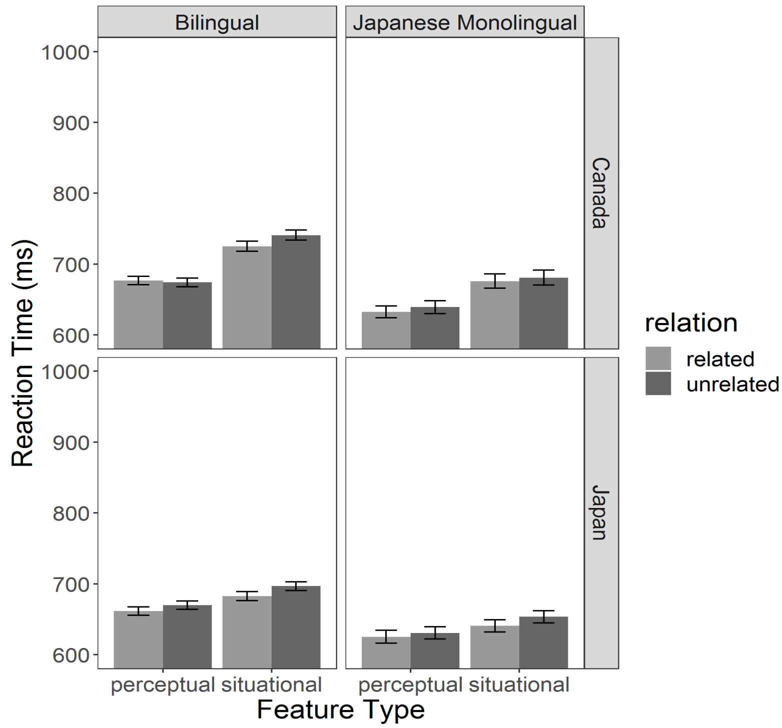

Figure 3. 24. Group comparisons for reaction time in Japanese lexical decision.

3.4.3.3 L1 vs L2 Task Comparisons within Bilinguals

Model. The goal of the analyses was to investigate whether the size of bilinguals' priming effects depend on the language of the task, and whether the Relation x Language interaction depends on Culture Pair and/or Feature Type. Fixed factors included: Relation (Related vs. Unrelated, sum coded), Language (English vs. Japanese, sum coded), Culture Pair (Canadian vs. Japanese word-feature pairs; sum coded), Feature Type (Perceptual vs. Situational; sum coded), and their interaction terms. Random factors included: subject (random intercept and random slope adjustment for Relation, Language, Culture, and Feature Type) and items (random intercept only). Because the goal of the analyses was to investigate the group differences in any priming effects, only the relevant main effect (i.e., Relation) and interactions (i.e., interactions that contains Relation and Group) will be discussed in the results below.

Results

Error data. The model is presented in Table 3.23. There was a significant main effect for Relation (χ^2 (1) = 4.50, $p < .05$). As seen in Figure 3.25, related pairs were responded to more accurately than unrelated pairs across all conditions. None of the interactions of interests were significant. See Appendix I and J for the exact mean values.

Table 3. 23. Model of L1 vs L2 Comparisons for Errors in Lexical Decision

Fixed-effects	*b*	*SE*	*z*	*p*
Intercept	-3.41	0.14	-24.94	$p < .001$
Relation	0.14	0.06	2.12	$p < .05$
Language	-1.23	0.13	-9.40	$p < .001$
Culture Pair	-0.21	0.24	-0.87	*ns*
Feature Type	0.45	0.24	1.87	.06
Relation x Language	-0.18	0.13	-1.40	*ns*
Relation x Culture Pair	0.09	0.12	0.74	*ns*
Language x Culture Pair	0.16	0.13	1.24	*ns*
Relation x Feature Type	-0.02	0.12	-0.18	*ns*
Language x Feature Type	-0.69	0.13	-5.29	$p < .001$
Culture Pair x Feature Type	0.23	0.48	0.49	*ns*
Relation x Language x Culture Pair	0.06	0.24	0.24	*ns*
Relation x Language x Feature Type	0.05	0.24	0.22	*ns*
Relation x Culture Pair x Feature Type	0.10	0.24	0.22	*ns*
Language x Culture x Feature Type	-0.61	0.24	-2.51	$p < .05$
Relation x Language x Culture x Type	0.43	0.48	-2.51	*ns*

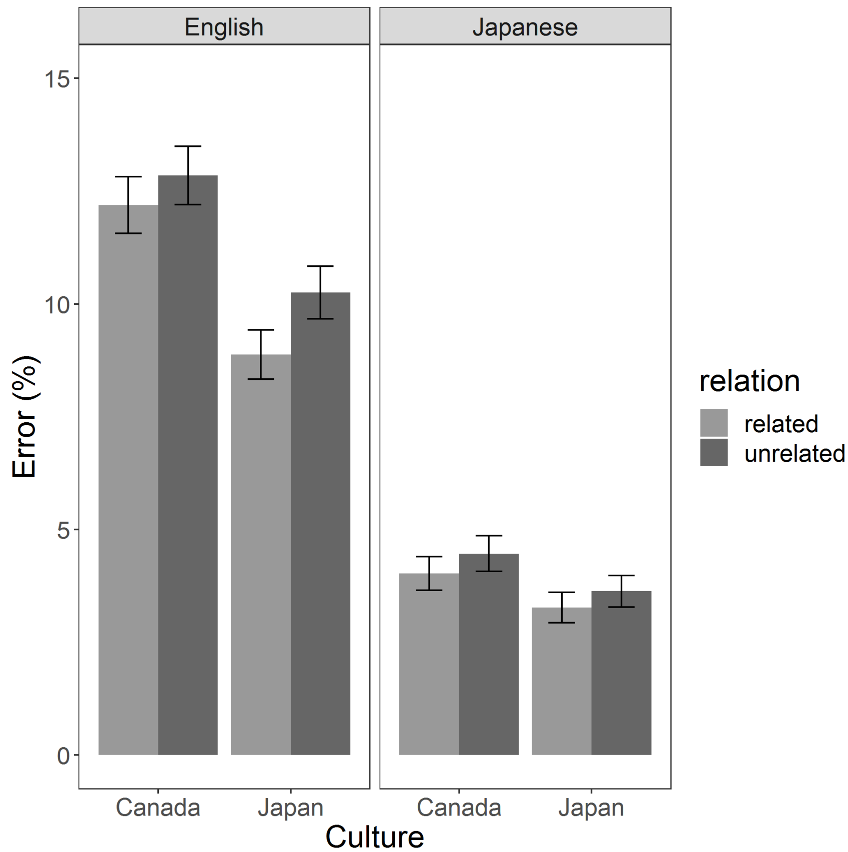

Figure 3. 25. L1 vs L2 comparisons for error rates in lexical decision.

Reaction time data. The model is presented in Table 3.24. First, there was a significant main effect for Relation ($\chi^2(1) = 27.04$, $p < .001$). None of the two-way interactions of interest were significant. Importantly, there was a significant Relation x Language x Culture Pair (χ^2 (1) = 7.04, $p < .01$) interaction. Post hoc comparisons revealed that when the words were in English, there were significant priming effects for both pairs with Canadian-specific features ($t = 3.88$, $p < .001$) and Japanese-specific features ($t = 2.38$, $p < .05$). However, when the words were in Japanese, a priming effect was only present for pairs with Japanese-specific features ($t = 3.14$, $p < .01$) but not for pairs with Canadian-specific features ($t = 1.03$, $p = .30$) (See Figure 3.26). Finally, no other three-way interactions of interest were significant. See Appendix I and J for the exact mean values.

Table 3. 24. Model of L1 vs L2 Comparisons for Reaction Time in Lexical Decision

Fixed-effects	*b*	*SE*	*t*	*p*
Intercept	-1.387	0.029	-47.07	$p < .001$
Relation	0.024	0.004	5.91	$p < .001$
Language	-0.377	0.027	-14.06	$p < .001$
Culture Pair	-0.031	0.029	-1.09	*ns*
Feature Type	0.091	0.029	3.16	$p < .01$
Relation x Language	-0.002	0.008	-0.19	*ns*
Relation x Culture Pair	0.004	0.008	0.45	*ns*
Language x Culture Pair	-0.040	0.008	-4.94	$p < .001$
Relation x Feature Type	0.006	0.008	-0.79	*ns*
Language x Feature Type	-0.030	0.008	-3.72	$p < .001$
Culture Pair x Feature Type	0.022	0.057	0.39	*ns*
Relation x Language x Culture Pair	0.039	0.016	2.38	$p < .05$
Relation x Language x Feature Type	0.047	0.016	2.89	$p < .01$
Relation x Culture Pair x Feature Type	-0.014	0.016	-0.89	*ns*
Language x Culture Pair x Feature Type	-0.137	0.016	-8.42	$p < .001$
Relation x Language x Culture Pair x Type	-0.004	0.032	-0.12	*ns*

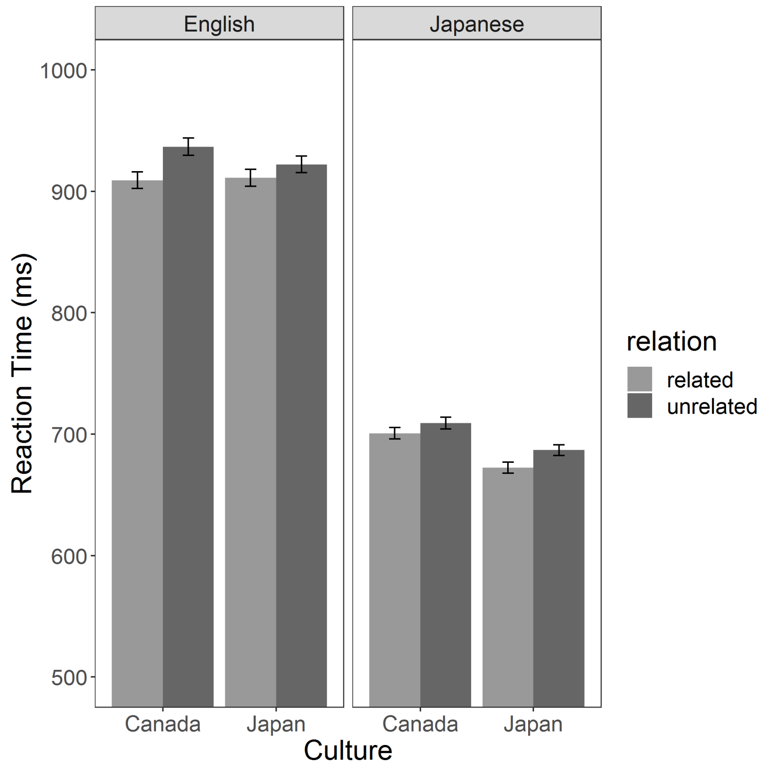

Figure 3. 26. Relation x Language x Culture Pair interaction in L1 vs L2 comparisons for lexical decision reaction time.

3.4.3.4 The Effects of Individual Differences

Model. The goal of the analyses was to investigate whether the size of bilinguals' priming effects depends on individual differences (L2 Proficiency and Cultural Exposure). The initial baseline model (Model 0) for these analyses included the main effects for five factors (Relation, Culture Pair, Feature Type, L2 Proficiency, and Cultural Exposure) and the same random intercepts and slopes used in the typicality rating and feature verification data analyses. Of interest was whether there was a significant effect of Relation (an overall priming effect). I then investigated whether the addition of the Relation x Culture Pair interaction to the model (Model 1) improved the model fit in order to assess whether priming effects for pairs with Canadian- and/or Japanese-specific features differed. Next, I added the Relation x Feature Type interaction to the baseline model (Model 2) to see whether priming effects differed depending on the type of feature. Then, the Relation x Culture Pairs x Feature Type interaction was added to a model that consisted of the baseline model along with all relevant double interactions

(Relation x Culture Pair, Relation x Feature Type, Culture Pair x Feature Type) (Model 3). This full model was compared to a reduced model that was the same but without the triple interaction (Model 3 Reduced). If the addition of the triple interaction significantly improves the model fit, this would indicate that the type of feature differentially affected priming for the Canadian and Japanese culture pairs.

The next step was to explore the impact of the individual differences variables, L2 Proficiency and L2 Cultural Exposure, on priming effects for Canadian and Japanese culture pairs. That is, I examined whether including the triple interactions of Relation x Cultural Pair x Proficiency (Model 4) or Relation x Culture Pair x Cultural Exposure (Model 5) improved the fit of models that were the same except that they did not include the triple interaction. All models included the initial baseline model and all relevant double interactions, and the random the intercepts for subjects and items, as well as by-subject random slope for Culture Pair and by-item random slope for L2 Proficiency.

English (L2) Task

Error data. The baseline model is presented in Table 3.25. The analyses revealed that there was a main effect of Relation (χ^2 (1) = 7.23, $p < .01$). Related pairs (10.5%) were responded to more accurately than unrelated pairs (11.6%). Model fit was not significantly improved by the addition of any interactions of interest.

Reaction time data. Only data from trials that were responded to correctly were included in the analyses. In addition to the removal of data without typicality ratings, an additional 10.5% of the original data were removed from the analyses due to errors. The baseline model (see Table 3.25) revealed that there was a significant main effect of Relation (χ^2 (1) = 29.85, $p < .001$). Related pairs (904 ms) were responded to faster than unrelated pairs (924 ms). Again, none of the interactions of interest significantly improved the model fit.

Table 3. 25. Baseline Models (Model 0) from English Lexical Decision Task

	Errors				Reaction Time			
Fixed-effects	*b*	*SE*	*z*	*p*	*b*	*SE*	*t*	*p*
Intercept	3.01	0.17	17.86	$p < .001$	-1.194	0.032	-36.80	$p < .001$
Relation	-0.19	0.07	-2.69	$p < .01$	0.026	0.004	5.46	$p < .001$
Culture Pair	0.06	0.30	0.20	*ns*	0.011	0.030	0.39	*ns*
L2 Proficiency	0.19	0.10	1.98	$p < .05$	-0.061	0.028	-2.17	$p < .05$
Culture Exposure	0.29	0.11	2.59	$p < .001$	-0.012	0.028	-0.22	*ns*
Feature Type	-0.63	0.28	-2.21	$p < .01$	0.048	0.030	2.83	$p < .01$

Japanese (L1) Task

Error data. The baseline model is presented in Table 3.26. There was a significant main effect of Relation (χ^2 (1) = 7.23, $p < .01$). Contrary to the expectation, related pairs (3.8%) were responded less accurately than unrelated pairs (2.6%). As for the English lexical decision task, model fit was not significantly improved by the addition of any interaction of interest.

Reaction time data. Errors were made on 3.9% of all trials and these were excluded from the analyses. The baseline model (see Table 3.26) revealed that there was a significant main effect of Relation (χ^2 (1) = 13.74, $p < .001$). Related pairs (686 ms) were responded to faster than unrelated pairs (695 ms). Similar to the error data, none of the interactions of interest improved the model fit.

Table 3. 26. Baseline Models (Model 0) from the Japanese Lexical Decision Task

	Errors				Reaction Time			
Fixed-effects	*b*	*SE*	*z*	*p*	*b*	*SE*	*t*	*p*
Intercept	3.982	0.147	27.06	$p < .001$	-1.577	0.031	-50.93	$p < .001$
Relation	-0.078	0.097	-0.80	*ns*	0.023	0.006	4.00	$p < .001$
Culture Pair	0.099	0.238	0.42	*ns*	-0.056	0.027	-2.05	$p < .05$
L2 Proficiency	-0.015	0.103	-0.15	*ns*	-0.053	0.030	-1.76	$p = .08$
Culture Exposure	-0.091	0.112	-0.81	*ns*	0.135	0.031	4.43	$p < .001$
Feature Type	-0.196	0.112	-0.87	*ns*	0.077	0.027	2.84	$p < .01$

3.4.4 Summary

Differences between monolinguals and bilinguals were observed in the pattern of semantic priming effects, particularly in the English error data. In the English task, a priming effect for pairs with Japanese-specific features was present in bilinguals but not in English monolinguals. These priming effects for bilinguals suggest that they have stronger L2 word – L1 feature connections compared to English monolinguals, which is evidence that they exhibit a semantic accent in their L2. On the other hand, the priming effect for pairs with Canadian-specific features was marginal for bilinguals while it was significant in English monolinguals. This finding implies that bilinguals have weaker L2 word – L2 feature connections than English monolinguals. This pattern of results was not present in the reaction time data. In the Japanese task, Cultural pair had no impact on the size of priming effects. Bilinguals showed no priming effect in the Error data, unlike Japanese monolinguals, but they produced similar priming effects as monolinguals in the latency data. Furthermore, the pattern of priming effects differed depending on the language of the task within bilinguals, particularly in the reaction time data. While priming effects for pairs with Japanese-specific features were present in both English and Japanese tasks, a priming effect for pairs with Canadian-specific features was only present in the English task. These findings suggest that L2 features are more accessible when processing in L2 than in L1, providing evidence of conceptual asymmetry in bilinguals. Finally, neither L2 Proficiency nor L2 Cultural Exposure had a significant influence on the size of the priming effect, possibly because priming effects were relatively small.

3.5 Discussion

The goal of the current study was to investigate semantic accents in Japanese-English bilinguals using a feature-based approach. Bilingual conceptual representations have often been described as having featural representations (Ameel, Malt, Storms, & Assche, 2009; Hartanto & Suarez, 2016; Malt & Lebkuecher, 2017). However, empirical evidence for such an account is mostly based on object naming studies and few studies have directly examined word-feature connections. To fill this gap and to further explore the development of semantic accents, I tested the predictions of the SDA model (Dong, et al., 2005), and also explored how other factors, including the amount of cultural exposure and feature type, influence the development of bilingual semantic accents. In the SDA model, low proficiency bilinguals are expected to exhibit semantic accents in their L2 because they have weak or no links to L2-specific features and they have connections between L1-specific features and L2 words which the monolinguals of the L2 do not have. However, more proficiency in L2 leads them to develop L2 word to L2 element connections and to have weaker L2 word to L1 element connections, which reduces their semantic accent in their L2. For their L1, on the other hand, more L2 proficiency leads bilinguals to develop semantic accents because the L2-specific elements they have acquired can develop some connection to their L1 words. Although the comparisons between bilinguals and monolinguals on the feature-based tasks revealed that bilinguals exhibit semantic accents in both L1 and L2, the current results did not support the assumption that it is increasing L2 proficiency that drives the changes in conceptual representations. Instead, Length of Residency (LOR) in L2 speaking countries was found to be an important factor that impacts bilinguals' conceptual representations. No significant impact of feature type was observed in the current experiments. Three main findings and their implications are discussed in the next three sections.

3.5.1 Semantic Accents: Differences Between Bilinguals and Monolinguals

One of the goals of the current study was to investigate semantic accents using feature-based tasks. Previous studies of object naming suggest (Ameel et al., 2005, 2009) that bilinguals' conceptual representations of L1 and L2 words are more similar to each other than those of monolinguals in each language. This is thought to be caused by the interaction between L1 and L2, leading bilinguals to activate somewhat different conceptual representation for L1 and L2 words compared to their monolingual counterparts (De Groot, 2014). I examined the presence of semantic accents by comparing the task performance of Japanese-English bilinguals with that of Japanese and English monolinguals. Using language-specific word-feature pairs, the current study observed semantic accents in experiments that involved three different tasks, including feature typicality rating, feature verification, and lexical decision tasks. The overall results from the experiments showed that semantic accents were more salient in English (L2) compared to Japanese (L1), which seems reasonable given that most bilinguals had

Japanese as their dominant language and there was already a well-established L1 representation before L2 learning began.

All three tasks performed in English (which involved comparisons between bilinguals and English monolinguals) revealed that bilinguals had semantic accents in English. In the feature typicality rating and the feature verification tasks, the bilinguals perceived Japanese-specific features to be more representative of the word and Canadian-specific features to be less representative compared to English monolinguals. In the priming task, the bilinguals produced a priming effect for pairs with Japanese-specific features and a marginal priming effect for pairs with Canadian-specific features, while English monolinguals showed the priming effect only for Canadian-specific features. These findings indicate that that the bilinguals have weaker connections to Canadian-specific (L2) features and stronger connections to Japanese-specific (L1) features compared to English monolinguals. The difference in priming effects between bilinguals and monolinguals in Experiment 3 provides particularly strong evidence because it indicates that the accents in L2 can be observed even if bilinguals do not explicitly seek the relationship between words and features.

In contrast, the results from the Japanese tasks revealed that bilinguals and Japanese monolinguals differed only in the feature typicality ratings and the feature verification tasks but not in the lexical decision task. For the feature typicality rating and feature verification tasks, the bilinguals perceived Canadian-specific features to be more representative of the word compared to Japanese monolinguals, but both groups responded similarly to the Japanese-specific features. These findings indicate that bilinguals' semantic accents in L1 mainly arose from their knowledge of L2-specific features, while the acquisition of L2 does not necessarily weaken the L1-specific word-feature connections. In other words, the source of semantic accents in L1 mainly comes from the transfer of L2-specific features, but not from the loss of L1-specific features. In the lexical decision task, between group differences were not observed, which is possibly because semantic accents in L1 were relatively subtle compared to the accents in L2. The finding of a semantic accent in L1 is consistent with the predictions of the SDA model for highly proficient bilinguals.

3.5.2 L1 and L2 Conceptual Asymmetry in Bilinguals

While the comparison between bilinguals and monolinguals revealed that words in one language (e.g., L2 word *pumpkin*) can activate word meanings from the other language (e.g., "is green" from the L1word *kabocha*), the current results indicate that bilinguals do not develop conceptual representations that are completely converged. In the SDA model, except for the case of low proficiency bilinguals who only possess conceptual knowledge based on their L1, proficient bilinguals are assumed to develop asymmetrical conceptual representations. More specifically, they develop stronger language-congruent connections (i.e. L2 and L2 features, L1 and L1 features) than language-incongruent connections (i.e., L2 and L1 features, L1 and L2 features). Thus, while their L1 and L2 conceptual representations are more similar than those found in monolinguals from each language, proficient bilinguals are expected to activate somewhat different conceptual representations depending on the language they are using. This conceptual asymmetry in L1 and L2 translation equivalent words has been supported by an object naming study by Jared, Poh, and Paivio (2013), which demonstrated that bilinguals respond to culturally biased images of objects faster when the language of the task is congruent. The purpose of the study was to find such conceptual asymmetry at the feature-level.

Consistent with the SDA model, the current study provides evidence that proficient bilinguals activate somewhat different conceptual information depending on the language of task (although the extent of the difference varies depending on LOR, which will be discussed in detail in the next section). The results from the feature typicality rating and feature verification tasks revealed that the bilinguals on average perceived Canadian-specific features (L2) to be more representative of words in the English (L2) task than in the Japanese (L1) task, while Japanese-specific features (L1) were more representative in the Japanese (L1) task than in the English (L2) task. That is, these findings provide evidence for stronger connections for language-congruent word-feature pairs (e.g., pairs with Canadian-specific features in the English task) compared to language-incongruent pairs (e.g., pairs with Canadian-specific features in the Japanese task). It is important to note that the finding does not necessarily indicate that bilinguals have independent conceptual stores for each language, given that bilinguals exhibit semantic accents that arise from conceptual transfer from the other language. Rather, the current study provides clear evidence that language-specific conceptual information for translation equivalent words is linked with L1 and L2 word forms at different strengths.

In the lexical decision task, semantic priming effects were found in pairs with Japanese-specific features regardless of the language of the task, indicating that Japanese features have strong connections to word forms in both languages. This finding seems to be consistent with the SDA model's predictions for less proficient bilinguals, who are assumed to possess stronger connections between L2 words and L1 features than more proficient bilinguals, causing them to have semantic accents in their L2. This result, along with the findings from the other two tasks may indicate that L2 word and L1 features connections are strong, and that they take a long time to weaken even though bilinguals may be consciously aware that L1 features are less relevant when processing L2 words. On the other hand, the priming effect for pairs with Canadian-specific features was only found in the English task and not in the Japanese task. This is a particularly interesting finding because it provides evidence that bilinguals are not merely learning new features for a word, but those acquired conceptual features are linked to word forms in each language at different strengths, causing asymmetrical conceptual representations.

Overall, while connection strengths between words and language-specific features are likely to change over time, the comparison of bilinguals' performance in L1 and L2 tasks on average indicates that they activate language-specific features to different degrees depending on the language of the task. Therefore, while the previous section suggested that bilinguals activate somewhat different word meanings compared to monolinguals due to their knowledge of their other language, it does not mean that their conceptual knowledge is connected to both L1 and L2 words at equal strength. Instead, the results indicated that bilinguals develop stronger word-feature connections when the combinations are language-congruent (e.g. L2 words and L2 features) compared to those that are incongruent (e.g., L2 words and L1 features).

3.5.3 The Development of Bilingual Conceptual Representations: The Effects of Individual Differences

The results from the feature typicality rating and feature verification tasks revealed that the development of bilingual conceptual representations is influenced by the length of residence (LOR) in L2 speaking countries, but not by L2 proficiency. This finding is not consistent with the SDA model, which claims that L2 proficiency is the major factor that contributes to the development of bilingual conceptual representations. According to the predictions from the SDA model, more L2 proficiency would reduce semantic accents in bilinguals' L2 by developing stronger connections to L2-specific features and weakening the links to L1-specific features. On the other hand, greater L2 proficiency would lead to stronger semantic accents in their L1 due to the influence of their L2 knowledge. The results of the current study, however, indicate that more L2 proficiency does not lead to a significant change in the connection strength between words and language-specific features. Instead, longer LOR led bilinguals to develop stronger connections between L2 words and L2 features as well as weaker connection between L2 words and L1 features, resulting in weaker L2 semantic accents. Furthermore, longer LOR also resulted in stronger connections between L1 words and L2 features, leading bilinguals to exhibit semantic accents in their L2. These findings are evident from the analyses indicating that bilinguals with no experience residing in L2-speaking countries had little change in their semantic accents regardless of their L2 proficiency.

The influence of such individual differences, however, was not found in the semantic priming task. More specifically, the presence or the size of semantic priming effect was not modulated by either L2 proficiency or the LOR. This is possibly because priming effects were too small to observe gradual change as a function of either variable.

One important finding regarding the effect of LOR is that the data from the feature typicality rating task and the feature verification task indicate somewhat different conclusions about how Japanese-specific features are perceived by bilinguals with different degrees of LOR. In both Japanese and English tasks, the typicality ratings for pairs with Japanese-specific features declined with more LOR, while the verification rates remained unchanged regardless of LOR. This may indicate that untimed explicit judgment is more sensitive to subtle changes in how bilinguals consciously perceive certain word-feature pairs. On the other hand, the responses on the speeded binary decision task may indicate that, at a more implicit level of processing, the connections between L1 specific word-feature pairs are less susceptible to change.

Another issue to note is that the data from the current study indicate no effect of L2 proficiency while other studies indicate that proficiency does impact bilinguals' conceptual representations (Dong et al., 2005; Hartanto & Suarez, 2016). One possible cause of the discrepancy may be differences in the stimuli selected. The current study employed 120 word-feature stimuli that ranged in domains of knowledge (e.g., visual feature, location, function) that can be experienced through physical experience of the surrounding environment. Dong et al. (2005), on the other hand, used only 16 groups of words and they had to limit the stimuli to nine groups of words to observe the effect of proficiency on the Chinese (L2) task. Thus, it might be the case that the language-specific conceptual information involved in some of their stimuli may be obtained through more experience with the language itself, not necessarily the physical cultural experience. Likewise, Hartanto and Suarez (2016) focused on gender information associated with words, which does not necessarily require cultural experience to acquire. Thus, it is quite likely that bilinguals' conceptual representations change as a function of L2 proficiency or/and L2 cultural exposure, depending on the kind of language-specific information.

3.5.4 Conclusions

The current study provides further insights into the nature of bilingual conceptual representations. Using language-specific word-feature pairs, I observed three main findings. First, the conceptual representations activated by translation equivalent words (1) were somewhat different between bilinguals and monolinguals (semantic accents were found both in L1 and L2), (2) depended on the language used within bilinguals (conceptual asymmetry), and (3) depended on the length of residence (LOR) in L2 speaking countries. While the first finding has been already observed in a number of object naming studies (Ameel et al., 2005; Zinszer et al., 2014; Malt et al., 2015; Pavlenko & Malt, 2011), the data from this study provides further understanding of semantic accents through examining the connection between words and language-specific features. The second finding implies that, while bilinguals' knowledge of each language is assumed to influence the other, L1 and L2 conceptual representations do not seem to completely converge, even in highly proficient bilinguals who have lived in L2-speaking countries for many years. As indicated in the SDA model, language-specific features seem to be connected more strongly to language-congruent words (e.g., *pumpkin* and "used to carve Jack O'Lantern") than language-incongruent words (e.g., *kabocha* and "used to carve Jack O'Lantern"), leaving bilinguals' conceptual representations for L1 and L2 asymmetrical. Most interestingly, the data from the current study did not support the prediction of the SDA model that L2 proficiency is the main influence on bilinguals' conceptual representations. Instead, LOR in L2 speaking countries was found to be a significant factor that impacts the nature of bilingual semantic accents. Although the effect of this variable is not specified in the model, the factor is likely to be critical in explaining the development of bilinguals' conceptual representations and should be taken into account in future research, particularly if their languages are from two very different cultures.

3.6 References

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4. General Discussion

The novel goal of this dissertation was to investigate bilingual conceptual representations taking a feature-based approach. Despite the fact that there are some existing feature-based bilingual models (e.g., Distributed Conceptual Feature model, Shared Distributed Asymmetrical model), semantic features have rarely been used to evaluate their claims. By focusing on Japanese-English bilinguals, the present research provides further insights into how semantic features can represent conceptual differences between translation equivalents in English and Japanese, and how those language-specific features are activated in bilinguals who may differ in L2 proficiency and extent of L2 cultural immersion.

In Chapter 2, the comparison of English and Japanese feature production norms provided empirical evidence that English speakers and Japanese speakers possess somewhat different conceptual knowledge even if words are considered as translation equivalents. The differences between English and Japanese speakers were observed at both a global level (i.e., overall frequency distribution of different feature types) and at the individual feature level (i.e., the presence of language-specific features).

Using the insights obtained from the study in Chapter 2 and the Shared Distributed Asymmetrical (SDA) model (Dong, Gui, & MacWhinney, 2005) as a guiding framework, I then examined bilingual conceptual representations in Japanese-English bilinguals using both explicit (i.e., feature typicality rating and feature verification) and implicit (i.e., semantic priming with lexical decision) tasks. The results from Chapter 3 were informative regarding the nature of semantic accents in bilinguals. More specifically, evidence for semantic accents in L2 was observed in the findings that bilinguals tend to have stronger connections between L2 words and L1-specific features and weaker connections between L2 words and L2-specific features compared to English monolinguals. The data from the lexical decision task indicated that bilinguals exhibit accents in their English (L2) even if they are not explicitly seeking relations between words and features, which provides strong evidence for the existence of semantic accents. Furthermore, evidence for a semantic accent in L1 was obtained in the finding that bilinguals have stronger connections between L1 words and L2-specific features compared to Japanese monolinguals. Also, the comparison of performance on L1 and L2 tasks revealed that, on average, the bilinguals activated language-specific features more when the language of the task was congruent than when it was incongruent, suggesting conceptual asymmetry between translation equivalent words. Importantly, the findings suggested that length of residence in L2-speaking countries is a significant factor that impacts the nature of bilingual semantic accents. More specifically, more years living in L2-speaking countries led bilinguals to have reduced semantic accents in their L2, while it increased semantic accents in their L1. Contrary to the prediction of the SDA model, however, L2 proficiency did not influence connection strengths between concepts and language-specific features. The developmental change in semantic accents was most clearly observed in the feature typicality task, which involved untimed explicit judgment.

4.1 Theoretical Implications

Although I used the SDA model as the guiding framework for my research, the current results also have implications for other theories of bilingual conceptual representation. For example, the Bilingual Dual-Coding (BDC) theory (Paivio & Desrochers, 1980) assumes that imagens and their verbal referents in each language can be connected with different strengths, particularly when the two languages are learned sequentially or in different cultural contexts. The current research involved sequential Japanese-English bilinguals, and consistent with BDC theory, the findings from the comparison of performance in L1 and L2 provide evidence that bilinguals activate language-specific conceptual representations more when the language of the task is congruent (e.g., L2 word and L2 feature pairs) than when it is incongruent (e.g., L1 word and L2 feature pairs). As for semantic accents, the BDC theory would explain the difference between bilinguals and monolinguals by claiming that bilinguals who acquired their two languages in different learning contexts would have a different mix of imagens than monolinguals living in one of those contexts. Some of their imagens would be acquired only in one context, and monolinguals in the other context may not have the opportunity to acquire them. Such context-specific imagens could influence the conceptual representations of both languages because of the connections between translation equivalent words. The BDC theory can account for the effects of L2 cultural immersion that were observed in the study because it assumes that learning contexts impact the nature of conceptual representations. However, the learning contexts can include multiple factors (e.g., age of acquisition, cultural contexts, amount of exposure to each language), and the theory needs to be more specific in terms of how each factor may influence on the development of bilingual conceptual representations. One challenge of the BDC theory is to characterize the subtle conceptual differences between translation equivalent words in a way that can easily be studied. A more useful way to represent such information is to use features.

The Distributed Conceptual Feature (DCF) model (Van Hell & De Groot, 1998) can also account for the conceptual asymmetry and semantic accents discussed above. The DCF model, which inspired the SDA model, assumes that conceptual information is represented in terms of features, which may or may not be shared between the two languages. Like the SDA, semantic accents in L2 can occur because of connections between L2 words and L1-specific features, or weak or non-existent connections between L2 words and L2-specific features, and semantic accents in L1 can occur because of connections between L1 words and L2-specific features. Again, like the SDA, conceptual asymmetry can be represented by translation equivalent words that do not activate the same sets of features, or activate similar sets of feature at different strengths. Thus, the model can represent specific static states of bilingual conceptual representations. However, the model specifies neither how activation patterns of features are expected to change with increasing knowledge of L2 nor with increasing experience with L2 cultural exposure.

A type of model that may be able to account for multiple developmental factors is the Self-Organizing Map (SOM) model. SOM models have been used to simulate various bilingual phenomena at different levels of language representation, and are not limited to semantic representations. They are connectionist models with an unsupervised learning algorithm. The knowledge representation (e.g., semantics, phonology) on a map or maps, which emerges through the training of the network, is assumed to be distributed and interactive in nature. The particular model that is most relevant to the present research is the SOM-based model developed by Fang, Zinszer, Malt, and Li (2016), because semantic information is represented on the conceptual map using semantic features. This allows the model to represent subtle differences in the conceptual representation of translation equivalent words. In this model, semantic accents can be accounted for by the cross-language connections between the features on the semantic map (e.g., "is green") and the lexical units on the phonological map (e.g., L2-phonological unit *pumpkin*). Conceptual asymmetry can be represented by the differences in sets of features connected to a lexical phonology unit in each language (e.g., the lexical representations *pumpkin* [L2] and *かぼちゃ* [L1] on the phonological map do not activate the same sets of features on the semantic map).

In Fang et al. (2016), the researchers only simulated the case of simultaneous French-Dutch bilinguals who learned their two languages in the same cultural environment. However, an important characteristic of the SOM-based model is that the nature of semantic representations and the connections with the lexical units in the phonological map change dynamically depending on how the network is trained. In other words, the model has the flexibility to allow researchers to manipulate various factors, such as the age of acquisition and the materials used to simulate semantic overlap, in order to simulate the particular effects of those factors. This also means that the model can simulate the effects of factors that are difficult to control in the real world, including L2 proficiency and L2 cultural immersion. Those two factors can be manipulated in the framework of the SOM, because they can be represented in two different components in the model. Specifically, language proficiency can be considered as the connection between the semantic map and phonological map (i.e., how well linguistic inputs in either language activate semantic representations), while the difference in L2 cultural experience can be represented in the content of the semantic map (i.e., the features contained in the semantic map would be different when one is immersed in the single culture or two different cultures). Thus, the SOM model seems to have a great potential to simulate and to compare conceptual representations for bilinguals who may differ in both proficiency and cultural factors. For example, difference in language proficiency can be simulated by the connection strength between the semantic map and lexical representations for each language in the phonological map, and bilinguals who are immersed in two different cultures can be simulated using semantic features that are derived from feature norms in the two languages rather than one. This way, it is possible to infer how different degrees of L2 cultural exposure would impact bilinguals' conceptual representations in each language, while controlling the level of language proficiency.

4.2 Practical Implications

In general, foreign accents have been predominantly discussed with respect to the phonological aspects of language. However, my study indicates that semantic accents are also present in many bilinguals, although they may not be recognized as easily by conversational partners, especially when language is only used in limited situations. The findings from this thesis clearly demonstrate that many translation equivalent words convey somewhat different conceptual information, and that learning a new L2 word itself does not lead one to acquire the same conceptual knowledge as a native monolingual speaker. These findings provide some implications for the challenges experienced in second language education, particularly for late L2 learners.

One concern arises from a common approach to foreign language instruction, which is to learn new words through translation. While this approach seems to be efficient at first, both instructors and learners need to be aware that it can cause heavy semantic accents by inducing learners to overextend L1-specific meanings to L2 words. This overextension of language-specific meanings may cause the difficulty in understanding conversation between monolinguals and L2 speakers. One suggestion for foreign language instructors is to teach new words by contrasting them with the meanings of L1 translation words for their students. For example, they could introduce the English word *pumpkin* as the translation equivalent of the Japanese word *かぼちゃ,* while pointing out that those words differ in how they typically look and how they are used in Japan and North America. Another way to reduce the overgeneralization of L1-specific meanings is to encourage students to learn about the culture of L2 and discuss the differences from their own culture. Such a teaching approach would be effective especially when words are learned with visual aids and contexts (e.g., pictures, video clips) rather than by memorizing them in isolation.

The current findings show that L2 cultural immersion rather than L2 proficiency is an important factor to acquire native-like conceptual knowledge for L2. This suggests that L2 acquisition may be more effective when learners are immersed in an L2 cultural environment through study abroad programs. It also indicates that linguistic knowledge, such as that tapped on typical vocabulary tests, may not always be an indication of the degree of one's semantic accent. This is because such conceptual knowledge may be more likely to be acquired through the perception and interaction with the concepts in the real world. Thus, a potential benefit of study abroad programs is not only the increased exposure to a second language, but also the physical exposure to the L2 cultural environment, which may help learners to develop L2 conceptual representations that are more similar to native speakers of the target language.

4.3 Limitations and Future Directions

One limitation of the present research is that it only examined one pair of translation equivalents for each concept, while in fact a word in one language can often have multiple possible translations. For example, the word *kettle* was translated as やかん in my studies but one could translate the word as ケトル instead. Although the words were selected carefully to represent the most typical translations, I did not set the clear criteria to define word pairs as translation equivalent. Future research could address this issue by showing possible translations to bilingual individuals and asking them to rank the translations in order from the most to least representative ones. Such a procedure will help to define what is considered to be the most reasonable translation when the words are presented in isolation, and also to examine whether language-specific features arise in those translation pairs.

Another limitation is that the feature norms collected in Chapter 2 are not necessarily comparable to existing norms in other languages, because the 80 words used in the current study were selected based on the expectation of finding differences between English and Japanese speakers that may arise from either linguistic or cultural differences. However, the findings indicate that speakers of different languages produce different features not only because the concepts are experienced differently depending on culture, but also that they seem to pay attention to different characteristics of concepts even for the features that are common in both languages. Therefore, future research that could extend the cross-language comparisons of feature norms would be to collect Japanese feature norms for the concepts that are already used in other studies, such the 50 concepts used in Kremer and Baroni (2011), which involved the comparison of German and Italian. Such norms will help further explore whether cultural differences between languages truly elicit greater differences in the feature norms compared the case when the difference is purely linguistic.

There are also a few limitations in the experimental tasks (i.e., feature typicality rating, feature verification, lexical decision) used in Chapter 3. One limitation is found in feature verification, where participants were asked to judge whether a feature (e.g., "is yellow") is reasonably true for a given word (e.g., "BUS"). While the reaction times were recorded with the expectation that they would reflect the connection strength between words and features (e.g., weaker connections would lead the participants to take a longer time to verify), the binary decisions made it difficult to interpret the results. That is, response latency may not necessarily reflect connection strength because weakly connected word-feature pairs may elicit either longer reaction times or a "NO" response. This might be one possible reason for the absence of clear evidence for semantic accents in the reaction time data of the feature verification task.

The lexical decision task provided some evidence for semantic accents in bilinguals' L2. However, differences between bilinguals and Japanese monolinguals were not observed in either error rates or reaction times. While this could be an indication that semantic accents in L2 may be stronger than in L1, feature typicality ratings and feature verification rates did indicate that the accents were observed in both L1 and L2. One possible reason for this inconsistency between different tasks may be the fact that the overall size of priming effects was too small to observe differences between bilinguals and monolinguals. In the current lexical decision experiment, participants were asked to respond to a word (e.g., "BUS"), which was preceded by a feature (e.g., "yellow"). However, language-specific features tend to be peripheral information that may be less likely to activate words compared to the other way around. That is, larger priming effects might be observed if participants made the judgments on features which are preceded by words.

Another way that may provide clearer differences in priming effects between words and features is to use event-related potentials (ERPs), because electrophysiological responses can be a more sensitive measure of priming effects. In a study in Chinese-English bilinguals, Wu and Thierry (2010) found priming effects in English word pairs (e.g., "experience" – "surprise") whose pronunciations of Chinese translation equivalents (i.e. "经验" – "惊讶") had sound repetition (经验 – "jing yan", 惊讶 – "jing ya"). This hidden sound repetition in the other language significantly modulated ERPs compared to unrelated pairs, while there was no difference observed in reaction times. Thus, the differences in priming effects between monolinguals and bilinguals might be observed more clearly in ERPs, particularly when the connections between words and features are not strong enough to produce the difference in reaction times. ERPs were not used in the current research because the participants were recruited in multiple locations in Canada and in Japan, and ERP equipment was not available in most locations. However, future research could take an advantage of ERPs by targeting bilinguals who are closer to ERP laboratories.

With regards to the development of bilingual conceptual representations, the current study focused on the influence of L2 proficiency and L2 cultural immersion. While the findings suggested the importance of L2 cultural immersion rather than the L2 proficiency, more research is needed to determine if there is a causal effect of L2 cultural immersion. This is challenging particularly because L2 immersion experience would influence factors other than the L2 cultural experience, such as the amount of L1/L2 language exposure. Nonetheless, there has been a study that attempted to investigate the effects of immersion by comparing individuals who stay in their home country and those who are immersed in an L2-speaking country. In Linck, Kroll, and Sunderman (2009), the researchers compared two groups of English-speaking learners of Spanish in terms of their access to L1 and L2; one group studied abroad in Spain for three months and the other group learned Spanish in a classroom setting at an American university for the same period of time. They found that the immersion group outperformed the classroom group in terms of L2 proficiency, while they underperformed in the tasks that required access to L1. The effects of cultural immersion on bilingual conceptual representation could also be investigated by making a similar comparison between two such groups of learners. However, the two groups of participants in Linck et al. significantly differed in the amount of exposure to each of their languages, and it is important to control this factor as much as possible. A better way to test the influence of cultural immersion would be to compare those who study abroad (i.e., cultural immersion group) to those who receive intensive exposure to L2 through a language immersion program at home (e.g., French immersion). This way, it is possible to see if the cultural immersion, rather than the increase in L2 exposure, has an influence on the nature of conceptual representations.

Another issue that should be addressed in future research is that whether a feature-based approach is useful in bilinguals with other language pairs. In the present research, the differences in translation equivalent words may have been particularly evident because of the cultural differences between Japan and Canada. However, such differences may be subtler when the two languages are used in the same cultural environment. While it has been suggested that conceptual differences in translation equivalent words do exist regardless of the similarity of the two languages (Van Hell & De Groot, 1998), more empirical studies are needed to explore whether language-specific features can be identified among languages that are more similar to each other (e.g., French and Dutch).

4.4 Conclusions

This thesis provides the groundwork for future research in bilingual conceptual representation through a feature-based approach. Semantic features provide many benefits in identifying how the elements of conceptual information may differ among languages and how those conceptual elements are represented in bilinguals. Previously, cross-language influences in bilingual conceptual representation have been mainly discussed in terms of the different patterns in object naming in L1 and L2 (De Groot, 2014), particularly in common household objects. Here, the results from the current thesis suggest that the unique quality of bilingual conceptual representations can be observed at the feature-level. That is, subtle conceptual differences that may be represented in the mind of bilinguals can be studied for a wide range of concepts using features. Given that featural representation does possess advantages over holistic representations, future studies should consider taking advantage of a feature-based approach in order to deepen our understanding of bilingual conceptual representation.

Furthermore, the present research also suggests that L2 cultural immersion has a significant impact on bilinguals' conceptual knowledge. This provides evidence that developmental changes in bilingual conceptual representations are unlikely to be explained solely by language proficiency. From a theoretical perspective, future bilingual research should focus more on how cultural or environmental factors could influence the relationship between conceptual representations and words in either language. From a practical perspective, this research suggests that native-like conceptual representations of L2 words can be effectively acquired through L2 cultural immersion.

Finally, this thesis rejects the common myth in bilingualism, which states that being a proficient bilingual is similar to being a monolingual speaker in each language. While the strength may depend on individuals, semantic accents seem to be an inherent characteristic in bilinguals. As the results suggest, bilinguals do not process word meanings in the same way as monolinguals, even in their native language. This is because the acquisition and use of a second language inevitably causes cross-language interactions, resulting in accents in both L1 and L2. These accents do not necessarily arise due to a lack of knowledge or skills, but instead they represent a unique quality in bilingualism.

4.5 References

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Appendices

Appendix A – List of Words Used for the Feature Production Task in Chapter 2

English	Japanese
air conditioner	エアコン
airplane	飛行機
airport	空港
bag	バッグ
balloon	風船
basement	地下室
bomb	爆弾
box	箱
bread	パン
bus	バス
butterfly	蝶
cake	ケーキ
car	車
carpet	カーペット
chair	椅子
church	教会
clock	時計
cockroach	ゴキブリ
comic	漫画
curry	カレー
dandelion	タンポポ
doll	人形
Dracula	ドラキュラ
drum	太鼓
eel	ウナギ
fence	塀
fish	魚
fridge	冷蔵庫
ghost	幽霊
guppy	グッピー
helicopter	ヘリコプター
hospital	病院
house	家
kettle	やかん
key	鍵
kite	たこ（凧）
lettuce	レタス
magazine	雑誌
mask	お面
microwave	電子レンジ
octopus	タコ
onion	玉ねぎ
paper	紙
paper lantern	ちょうちん
park	公園
pencil	鉛筆
pencil case	筆箱
piano	ピアノ
plate	皿
postcard	ハガキ
Public Phone	公衆電話
pumpkin	かぼちゃ
rice	米
rice cooker	炊飯器
rocket	ロケット
salmon	鮭
school	学校
school bus	スクールバス
shark	サメ
shelf	棚
ship	船
shrimp	海老
snail	カタツムリ
spider	蜘蛛
subway	地下鉄
sushi	寿司
sword	刀
taxi	タクシー
tea	お茶
textbook	教科書
theater	劇場
ticket	チケット
toilet	トイレ
tomato	トマト
towel	タオル

train	電車
tree	木
tuna	まぐろ

turtle	亀
water	水

Appendix B - Example of Each Feature Type Based on Brain Region Taxonomy

Feature Type	Examples
emotion	ghost <scary>, park <fun>, cockroach <disgusting>
encyclopaedic	bread <edible>, helicopter <expensive>, doll <pretty>
function	ship <used to travel>, kite <used by children>, lettuce <used to make salad>
location	fridge <found in kitchen, shark <lives in ocean>, pencil case <used at school>
smell	rice <smells nice>, toilet <smells bad>, tuna <smells like fish>
sound	bus <loud>, piano <makes sound>, clock <ticks>
taste	tea <tastes good>, cake <sweet>, curry <spicy>
taxonomic	onion <vegetable>, chair <furniture>, turtle <animal
time	air conditioner <used in summer>, bomb <used in war>, sushi <eaten at dinner>
touch	towel <soft>, water <cold>, textbook <heavy>
visual colour	paper <white, snail < brown, tomato < red
visual form and surface	butterfly <has wings>, microwave <rectangular>, shelf <made of wood>
visual motion	salmon <swims>, airplane <flies>, spider <crawls>

Appendix C – The Descriptions of Variables Included in the Production File

Variable	Description
Concept	concept name in English
Feature	feature name
BR_Label	feature type based on Cree and McRae's (2003) brain region taxonomy
Prod_Freq	production frequency

Appendix D – Example of a Word and the Features from English Feature Norms

Word	Feature	Production Frequency	Feature Type
air conditioner	air	2	encyclopaedic
	breaks	3	encyclopaedic
	breezy	2	encyclopaedic
	expensive	2	encyclopaedic
	fresh	2	encyclopaedic
	man made	2	encyclopaedic
	temperature	2	encyclopaedic
	blows air	5	function
	refreshing	2	function
	found in buildings	4	location
	goes through vents	2	location
	loud	8	sound
	makes noise	2	sound
	common utility	2	taxonomic
	machine	3	taxonomic
	object	2	taxonomic
	used in summer	9	time
	cold	8	touch
	cool	4	touch
	box	3	visual form and surface
	ducts	2	visual form and surface
	fan	5	visual form and surface
	large	3	visual form and surface
	made of metal	5	visual form and surface

Appendix E – Example of a Word and the Features from Japanese Feature Norms (translation in brackets)

Word	Feature	Production Frequency	Feature Type
エアコン (air conditioner)	リモコンで操作する (operated by a remote controller)	6	encyclopaedic
	便利である (convenient)	2	encyclopaedic
	値段が高い (expensive)	4	encyclopaedic
	快適 (comfortable)	2	encyclopaedic
	水もれする (has water leaks)	2	encyclopaedic
	節電 (saving electricity)	3	encyclopaedic
	電気を使う (uses electricity)	4	encyclopaedic
	風が出る (blows air)	8	encyclopaedic
	気温を調節する (used to adjust temperature)	4	function
	壁についている (found on wall)	5	location
	室内にある (found in rooms)	2	location
	音がうるさい (loud)	4	sound
	音が鳴る (makes sound)	3	sound
	家電製品 (appliance)	4	taxonomic
	機械 (machine)	6	taxonomic
	冬に使う (used in winter)	3	time
	夏に使う (used in summer)	6	time
	寒い (cold)	3	touch
	暖かい (warm)	6	touch
	涼しい (cool)	12	touch

	白 (white)	9	visual colour
	プラスチック製 (made of plastic)	2	visual form and surface
	四角い (rectangular)	5	visual form and surface
	横長 (horizontally long)	2	visual form and surface

Appendix F – Examples of Language-Specific Features

	English-Specific	Japanese-Specific (with translation)
emotion	kite <fun>	ゴキブリ<怖い> (cockroach <scary>)
encyclopaedic	public phone <unsanitary>	車 <危険> (car <is dangerous>)
function	bread <used to make sandwiches>	米 <おにぎりに使う> (rice<used to make rice balls)
location	comic <found in newspapers>	電子レンジ<コンビニにある> (microwave <found in convenience stores>)
smell	tuna <smells bad>	n/a
sound	bus <loud>	n/a
taste	rice <tastes bland>	かぼちゃ<甘い> (pumpkin <sweet>)
taxonomic	kettle <appliance>	ケーキ <食べ物> (cake <food>)
time	mask <used at masquerades>	凧 <正月に使う> (kite <used on New Year Day>)
touch	water <wet>	エアコン <暖かい> (air conditioner <warm>)
visual colour	taxi <yellow>	タコ <赤い> (octopus <red>)
visual form and surface	pencil <has eraser>	空港 <広い> (airport <spacious>)
visual motion	spider <eats flies>	寿司 <回転> (sushi <rotates>)

Appendix G – List of Critical Stimuli in Chapter 3

Word (English)	Feature (English)	Word (Japanese)	Feature (Japanese)	Culture	Type
air conditioner	made of metal	エアコン	鉄で出来ている	Canada	perceptual
apartment	has an elevator	アパート	エレベーターがある	Canada	perceptual
armour	made of steel	鎧	はがねで出来ている	Canada	perceptual
bag	made of plastic	袋	プラスチックで出来ている	Canada	perceptual
basement	has a washing machine	地下室	洗濯機がある	Canada	perceptual
car	has a steering wheel on the left	車	ハンドルが左側にある	Canada	perceptual
couch	has pillows	カウチ	枕がある	Canada	perceptual
cucumber	is straight	キュウリ	まっすぐである	Canada	perceptual
dishwasher	has a door	食器洗い機	ドアがある	Canada	perceptual
electrical outlet	has three holes	コンセント	穴が三つある	Canada	perceptual
fence	made of wood	塀	木で出来ている	Canada	perceptual
house	has a basement	家	地下室がある	Canada	perceptual
money	is colourful	お金	カラフルである	Canada	perceptual
mushroom	is white	きのこ	白い	Canada	perceptual
textbook	is heavy	教科書	重い	Canada	perceptual
apple	used to make sauce	りんご	ソースを作るのに使う	Canada	situational
avocado	used to make guacamole	アボカド	グアカモーレを作るのに使う	Canada	situational
barbeque	found in backyards	バーベキュー	裏庭にある	Canada	situational
bathtub	used for showers	浴槽	シャワーに使う	Canada	situational
canoe	used on lakes	カヌー	湖で使う	Canada	situational
deer	is edible	鹿	食べれる	Canada	situational

fireplace	found in houses	暖炉	家にある	Canada	situational
French fries	eaten with gravy	フライドポテト	グレービーをかけて食べる	Canada	situational
icing	used on a cake	アイシング	ケーキに使う	Canada	situational
lake	used for swimming	湖	泳ぐのに使う	Canada	situational
pencil case	holds a calculator	筆箱	電卓が入っている	Canada	situational
postcard	used while travelling	ハガキ	旅先で使う	Canada	situational
Santa	found in shopping malls	サンタ	ショッピングモールにいる	Canada	situational
squirrel	found in parks	リス	公園にいる	Canada	situational
tokens	used to ride the subway	トークン	地下鉄で使う	Canada	situational
broom	made of bamboo	ほうき	竹で出来ている	Japan	perceptual
coin	has a hole	硬貨	穴が開いている	Japan	perceptual
curry	contains carrots	カレー	ニンジンが入っている	Japan	perceptual
hair	is black	髪	黒い	Japan	perceptual
mailbox	has two slots	ポスト	口が二つある	Japan	perceptual
public phone	is green	公衆電話	緑色である	Japan	perceptual
rice	tastes sweet	米	甘い	Japan	perceptual
shower	has a hose	シャワー	ホースが付いている	Japan	perceptual
resume	is handwritten	履歴書	手書きである	Japan	perceptual
taxi	has an automatic door	タクシー	自動ドアがある	Japan	perceptual
tea	is a powder	お茶	粉末状である	Japan	perceptual
toilet	has a bidet	トイレ	ビデが付いている	Japan	perceptual
traffic light	plays a melody	信号	メロディーが鳴る	Japan	perceptual
vinegar	made of rice	酢	米から作られている	Japan	perceptual
umbrella	is transparent	傘	透明である	Japan	perceptual
ashtray	found in restaurants	灰皿	レストランにある	Japan	situational
bungalow	used when camping	バンガロー	キャンプで使う	Japan	situational

egg	used for sushi	卵	寿司に使う	Japan	situational
graduation	occurs in March	卒業式	三月におこなわれる	Japan	situational
grape	eaten by peeling the skin	ブドウ	皮を剥いて食べる	Japan	situational
greeting	accompanied by bowing	挨拶	お辞儀をする	Japan	situational
incense	found by grave stones	線香	墓石にある	Japan	situational
jar	created by potters	壺	陶芸家によって作られる	Japan	situational
marathon	occurs in the winter	マラソン	冬におこなわれる	Japan	situational
motor cycle	used for delivery	バイク	配達に使われる	Japan	situational
rabbit	seen in the moon	うさぎ	月に見られる	Japan	situational
rice cracker	eaten with tea	せんべい	お茶と食べる	Japan	situational
soybean	eaten fermented	大豆	発酵させて食べる	Japan	situational
uniform	worn in high school	制服	高校で着る	Japan	situational
seafood	used on pizza	シーフード	ピザに乗せる	Japan	situational
bacon	is crispy	ベーコン	カリカリしている	Canada	perceptual
bathroom	has a curtain	浴室	カーテンがある	Canada	perceptual
bread	has peanut butter	パン	ピーナッツバターが塗ってある	Canada	perceptual
building	made of bricks	建物	レンガで出来ている	Canada	perceptual
bus	is yellow	バス	黄色い	Canada	perceptual
checkout	has a conveyor belt	レジ	ベルトコンベアーがある	Canada	perceptual
comics	has superhero pictures	マンガ	スーパーヒーローの絵が描いてある	Canada	perceptual
drug store	has a post office	薬局	郵便局がある	Canada	perceptual
farm	has chickens	牧場	ニワトリがいる	Canada	perceptual
kettle	has an electrical cord	やかん	電源コードがある	Canada	perceptual
kitchen	has an oven	キッチン	オーブンがある	Canada	perceptual
parsley	has flat leaves	パセリ	平たい葉がある	Canada	perceptual

salmon	is pink	鮭	ピンクである	Canada	perceptual
subway	has graffiti	地下鉄	落書きがある	Canada	perceptual
teacup	has a handle	湯のみ	取っ手がある	Canada	perceptual
balloon	used at birthday parties	風船	誕生日会に使う	Canada	situational
basket	used at Easter	かご	イースターに使う	Canada	situational
broccoli	eaten raw	ブロッコリー	生で食べる	Canada	situational
campfire	used to roast marshmallows	キャンプファイヤー	マシュマロを焼くのに使う	Canada	situational
closet	used to store shoes	クローゼット	靴をしまうのに使う	Canada	situational
groceries	bought once a week	食料品	週一回買う	Canada	situational
gun	used for hunting	銃	狩猟に使う	Canada	situational
hockey	played on ice	ホッケー	氷の上でする	Canada	situational
mask	used at costume parties	お面	仮装パーティーで使う	Canada	situational
milk	comes in bags	牛乳	袋に入っている	Canada	situational
pine tree	used for Christmas decoration	松の木	クリスマスに使う	Canada	situational
pumpkin	used to make a pie	かぼちゃ	パイを作るのに使う	Canada	situational
snail	eaten as an appetizer	カタツムリ	前菜として食べる	Canada	situational
television	has a cable fee	テレビ	ケーブル料金がかかる	Canada	situational
tuna	found in cans	マグロ	缶に入っている	Canada	situational
beach	smells salty	ビーチ	潮の匂いがする	Japan	perceptual
bike	has a basket	自転車	かごが付いている	Japan	perceptual
cake	has strawberries	ケーキ	イチゴがある	Japan	perceptual
crane	made of paper	鶴	紙で出来ている	Japan	perceptual
dragon	looks like a snake	龍	蛇のような形である	Japan	perceptual
ghost	has long hair	幽霊	長い髪がある	Japan	perceptual
newspaper	is written vertically	新聞	縦書きである	Japan	perceptual

pear	is round	梨	丸い	Japan	perceptual
school	has a swimming pool	学校	プールがある	Japan	perceptual
stove	has a flame	コンロ	火が点く	Japan	perceptual
sun	is red	太陽	赤い	Japan	perceptual
temple	has graves	寺	墓がある	Japan	perceptual
tomato	tastes sour	トマト	酸っぱい	Japan	perceptual
train conductor	wears white gloves	車掌	白い手袋をはめている	Japan	perceptual
yoyo	contains water	ヨーヨー	水が入っている	Japan	perceptual
barrel	used to store sake	樽	酒の貯蔵に使う	Japan	situational
beer	sold in vending machines	ビール	自販機で売っている	Japan	situational
headband	used when playing a drum	はちまき	太鼓を叩くときに使う	Japan	situational
fish	eaten at breakfast	魚	朝食に食べる	Japan	situational
stone	used to sharpen a knife	石	包丁を研ぐのに使う	Japan	situational
goldfish	seen at festivals	金魚	お祭りで見られる	Japan	situational
grill	used to cook fish	グリル	魚を調理するのに使う	Japan	situational
hot spring	found in hotels	温泉	旅館にある	Japan	situational
kite	used at New Year's celebrations	たこあげ	正月にする	Japan	situational
spaghetti	eaten with ketchup	スパゲッティ	ケチャップを混ぜて食べる	Japan	situational
microwave	found in convenience stores	電子レンジ	コンビニにある	Japan	situational
octopus	caught in a jar	タコ	壺で捕まえる	Japan	situational
shark	eaten in soup	サメ	スープにして食べる	Japan	situational
unicycle	found in schoolyards	一輪車	校庭にある	Japan	situational
watermelon	eaten with salt	スイカ	塩をかけて食べる	Japan	situational

Appendix H – Items used for the Vocabulary Tests in Chapter 3

H1 – List of Items Used for the English Vocabulary Test

ablaze	word
allied	word
bewitch	word
breeding	word
carbohydrate	word
celestial	word
censorship	word
cleanliness	word
cylinder	word
dispatch	word
eloquence	word
festivity	word
flaw	word
fluid	word
fray	word
hasty	word
hurricane	word
ingenious	word
lengthy	word
listless	word
lofty	word
majestic	word
moonlit	word
muddy	word
nourishment	word
plaintively	word
rascal	word
recipient	word
savoury	word
scholar	word

scornful	word
screech	word
shin	word
slain	word
stoutly	word
turmoil	word
turtle	word
unkempt	word
upkeep	word
wrought	word
abergy	nonword
alberation	nonword
crumper	nonword
destription	nonword
exprate	nonword
fellick	nonword
interfate	nonword
kermshaw	nonword
kilp	nonword
magrity	nonword
mensible	nonword
plaudate	nonword
proom	nonword
pudour	nonword
pulsh	nonword
purrage	nonword
quirty	nonword
rebondicate	nonword
skave	nonword
spaunch	nonword

H2 – List of Items Used for the Japanese Vocabulary Test

Items	Translation	Word or Not
毒ガス	poison gas	word
枝豆	Soybeans in the pod	word
過ごす	spend	word
朝風呂	morning bath	word
そもそも	to begin with	word
見極める	ascertain	word
あべこべ	opposite	word
本題	the main subject	word
エンゲル係数	Engel's coefficient	word
泊り込む	to stay overnight	word
預け入れる	to make a deposit	word
言い直す	rephrase	word
たしなみ	a taste	word
英文学	English literature	word
はまり役	well-suited role	word
ごろ合わせ	a play on words	word
労力	labor	word
忍ばせる	conceal	word
勃発	an outbreak	word
宿無し	houselessness	word
目白押し	be filled with	word
請負い	contract	word
塗り箸	lacquered chopsticks	word
気丈さ	stoutheartedness	word
茶番	play a farce	word
大腿骨	a thighbone	word
術中	fall into the trap set by somebody	word
泌尿器	the urinary organs	word
血税	a tax paid by the sweat of one's brow	word
悶着	cause trouble	word
腰元	a lady in waiting (to Her Grace)	word
裾模様	a formal kimono with a design on the skirt	word
旗竿	a flagpole	word
かんじき	a pair of snowshoes	word
百葉箱	a ventilated case for meteorological instruments	word
迂曲	meandering	word
告諭	official notice	word

辻番	town-watches from the Edo period	word
ライニング	lining	word
輪タク	tricycle taxi	word
拶挨	nonword	nonword
モリラスト	nonword	nonword
ちっかり	nonword	nonword
席任	nonword	nonword
心不用	nonword	nonword
ややしこい	nonword	nonword
ソーシー	nonword	nonword
弾き富める	nonword	nonword
楽みし	nonword	nonword
チョレコート	nonword	nonword
能細胞	nonword	nonword
アプルス山脈	nonword	nonword
確めかる	nonword	nonword
伝言番	nonword	nonword
単時間	nonword	nonword
白面い	nonword	nonword
警札	nonword	nonword
知らべる	nonword	nonword
腹反	nonword	nonword
筋力トニーレング	nonword	nonword

Appendix I – Mean Reaction Time and Errors (in brackets) in English Lexical Decision Tasks

I1 – Bilinguals

Culture Pair		Related	Unrelated	Priming Effect
Canadian	Perceptual	880 (9.8)	911 (10.4)	31 (0.6)
	Situational	925 (14.4)	950 (15.3)	25 (0.9)
	Overall	902 (12.1)	930 (12.8)	28 (0.7)
Japanese	Perceptual	855 (5.3)	873 (6.9)	18 (1.6)
	Situational	964 (12.7)	970 (14.0)	6 (1.3)
	Overall	906 (8.9)	919 (10.4)	13 (1.5)
Total		904 (10.5)	924 (11.6)	20 (1.1)

I2 – English Monolinguals

Culture Pair		Related	Unrelated	Priming Effect
Canadian	Perceptual	646 (2.4)	655 (5.3)	9 (2.9)
	Situational	647 (2.9)	665 (5.0)	18 (2.1)
	Overall	646 (2.7)	660 (5.2)	14 (2.5)
Japanese	Perceptual	652 (4.3)	655 (5.0)	3 (0.7)
	Situational	688 (6.7)	707 (7.9)	19 (1.1)
	Overall	669 (5.5)	680 (6.5)	11 (1.0)
Total		658 (4.1)	670 (5.8)	12 (1.7)

Appendix J – Mean Reaction Time and Errors (in brackets) in Japanese Lexical Decision Tasks

J1 – Bilinguals

Culture Pair		Related	Unrelated	Priming Effect
Canadian	Perceptual	677 (3.9)	674 (4.4)	-3 (0.5)
	Situational	725 (4.7)	741 (4.6)	16 (-0.1)
	Overall	701 (4.3)	707 (4.5)	6 (0.2)
Japanese	Perceptual	662 (3.2)	670 (3.3)	8 (0.1)
	Situational	683 (3.5)	697 (4.3)	14 (0.8)
	Overall	672 (3.3)	683 (3.8)	11 (0.5)
Total		686 (3.8)	695 (2.6)	9 (-1.2)

J2 – Japanese Monolinguals

Culture Pair		Related	Unrelated	Priming Effect
Canadian	Perceptual	633 (3.2)	639 (6.0)	6 (2.8)
	Situational	676 (2.4)	681 (4.6)	5 (2.2)
	Overall	654 (2.8)	660 (5.3)	6 (2.5)
Japanese	Perceptual	625 (2.6)	631 (3.3)	6 (0.7)
	Situational	641 (2.3)	653 (4.1)	12 (1.8)
	Overall	633 (2.5)	642 (3.7)	9 (1.2)
Total		643 (2.6)	650 (4.5)	7 (1.9)

Appendix K – Ethical Approval for the Study in Chapter 2

K1 – English Feature Norm Study

Western Research

Research Ethics

Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Prof. Kenneth McRae
Department & Institution: Social Science\Psychology,Western University

NMREB File Number: 105326
Study Title: English feature norming study
Sponsor: Natural Sciences and Engineering Research Council

NMREB Initial Approval Date: June 09, 2014
NMREB Expiry Date: March 31, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Western University Protocol		2014/05/30
Letter of Information & Consent		2014/05/29
Instruments		2014/05/29

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer, on behalf of Riley Hinson, NMREB Chair

Ethics Officer to Contact for Further Information

Erika Basile ebasile@uwo.ca	Grace Kelly grace.kelly@uwo.ca	Mina Mekhail mmekhail@uwo.ca	Vikki Tran vikki.tran@uwo.ca

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Western University, Research, Support Services Bldg., Rm. 5150
London, ON, Canada N6A 3K7 t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/services/ethics

K2 – Japanese Feature Norm Study

Western Research

Research Ethics

Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Prof. Kenneth McRae
Department & Institution: Social Science\Psychology,Western University

NMREB File Number: 105295
Study Title: Japanese feature norming study
Sponsor: Natural Sciences and Engineering Research Council

NMREB Initial Approval Date: June 09, 2014
NMREB Expiry Date: March 31, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Instruments	Received 29Apr2014: Questionnaire (English translation of instructions)	
Other	Received 29Apr2014: English Debriefing Form	
Letter of Information & Consent	English Letter of Information and Consent	2013/11/18
Instruments	Received 29Apr2014: List of Stimuli	
Western University Protocol		2014/04/28
Recruitment Items	Announcement Script	2014/04/28

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

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The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer, on behalf of Riley Hinson, NMREB Chair

Ethics Officer to Contact for Further Information

Erika Basile ebasile@uwo.ca	Grace Kelly grace.kelly@uwo.ca	Mina Mekhail mmekhail@uwo.ca	Vikki Tran vikki.tran@uwo.ca

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Appendix L – Ethical Approval for the Study in Chapter 3

L1 – Experiments conducted in Canada

Western Research

Research Ethics

Western University Non-Medical Research Ethics Board
NMREB Amendment Approval Notice

Principal Investigator: Prof. Debra Jared
Department & Institution: Social Science\Psychology,Western University

NMREB File Number: 107721
Study Title: A study of conceptual representation
Sponsor: Natural Sciences and Engineering Research Council

NMREB Revision Approval Date: June 21, 2016
NMREB Expiry Date: March 14, 2017

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Revised Western University Protocol		2016/05/25
Recruitment Items	Revised Recruitment Script (Japanese and English)	2016/05/25
Letter of Information	Letter of Information for Japanese Monolinguals at Waseda University	2016/05/25
Letter of Information	Letter of Information used for bilinguals at Waseda University	2016/05/25
Revised Letter of Information & Consent	English (Received for Information) This is a translation of the letter used by Waseda in Japanese. The Western-approved LOI will be used for the bilingual participants tested in Canada. Received June 21, 2016.	2016/05/25

The Western University Non-Medical Science Research Ethics Board (NMREB) has reviewed and approved the amendment to the above named study, as of the NMREB Amendment Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer, on behalf of Dr. Riley Hinson, NMREB Chair

Ethics Officer: Erika Basile ___ Katelyn Harris ___ Nicole Kaniki ___ Grace Kelly ✓ Vikki Tran ___ Karen Gopaul ___

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L2 – Experiments conducted at Waseda University, Japan

Research Management Section No.164

CERTIFICATE OF APPROVAL
FOR RESEARCH WITH HUMAN SUBJECTS

This is to certify that the following research plan has been approved based on the assessment of the Ethics Review Committee on Research with Human Subjects of Waseda University.

Application No.: 2016-022

Title of Research Project: A study of conceptual representation

Head Researcher: **HINO,Yasushi**
Professor,Faculty of Letters,Arts and Sciences,
Waseda University

Representative Researcher: **HINO,Yasushi**
Professor,Faculty of Letters,Arts and Sciences,
Waseda University

Approval Date: 18 Month 2016

[Signature]______________________ [Official Seal]__________

KAMATA, Kaoru
President
Waseda University

Curriculum Vitae

Name: Eriko Matsuki (formerly Eriko Ando)

<u>EDUCATION</u>

2018 PhD Psychology, University of Western Ontario,
London, Ontario, Canada
Advisor: Debra Jared

2012 MSc Psychology, University of Western Ontario,
London, Ontario, Canada
Advisor: Debra Jared

2010 BA (honours) Psychology, Algoma University
Sault Ste. Marie, Ontario, Canada
Advisor: Dwayne Keough

<u>PEER-REVIEWED PUBLICATIONS</u>

Ando, E., Matsuki, K., Sheridan, H., & Jared, D, J. (2015). The locus of Katakana-English masked phonological priming effects. *Bilingualism: Language and Cognition, 18*(1), 101-117, DOI: 10.1017/S1366728914000121.

Ando, E., Jared, D., Nakayama, M., & Hino, Y. (2014). Cross-script phonological priming with Japanese Kanji primes and English targets. *Journal of Cognitive Psychology, 26*(8), 853-870, DOI: 10.1080/20445911.2014.971026

<u>INVITED TALK</u>

Ando, E., Jared, D., Hino, Y., Nakayama, M., & Ida, K. (2012, May). *Phonological Priming in Japanese-English Bilinguals: Evidence from Lexical Decision and ERP.* Waseda University, Tokyo, Japan.

<u>CONFERENCE PRESENTATIONS</u>

Matsuki, E., Hino, Y., & Jared, D, J. (2018, August). *How Do Japanese-English Bilinguals Process Word Meanings of Translation Equivalent Words?* Poster presented at the Annual Conference of Canadian Association for Japanese Language Education (CAJLE), London, Ontario, Canada.

Matsuki, E., Hino, Y., & Jared, D, J. (2017, November). *Semantic Accents in Bilinguals: A Feature-Based Approach.* Poster presented at the 58th Annual Meeting of Psychonomics Society, Vancouver, British Columbia, Canada.

Matsuki, E., Hino, Y., Matsuki, K., & McRae, K. (2017, November). *A Comparison of Japanese and English Feature Norms Using Translation Equivalent Words.*

Poster presented at the 58th Annual Meeting of Psychonomics Society, Vancouver, British Columbia, Canada.

Ando, E., Jared, D., Nakayama, M., & Hino, Y. (2014, October). *Cross-script phonological priming with Japanese Kanji primes and English targets.* Poster presented at the 9th Annual meeting of Mental Lexicon, Niagara-on-the-Lake, Ontario, Canada.

Ando, E., Matsuki, K., Sheridan, H., & Jared, D, J. (2013, November). *Are Japanese-English Phonological Priming Effects Lexical or Sublexical?* Poster presented at the 54th Annual Meeting of Psychonomics Society, Toronto, Ontario, Canada.

Ando, E., Jared, D., Hino, Y., Nakayama, M., & Ida, K. (2012, June). *Phonological Priming in Japanese-English Bilinguals: Evidence from Lexical Decision and ERP.* Poster presented at the 22nd Annual Meeting of the Canadian Society for Brain, Behavior and Cognitive Science, Kingston, Ontario, Canada.

Ando, E., Jared, D., Hino, Y., Nakayama, M., & Ida, K. (2012, March). *Interlingual phonological priming in Japanese-English bilinguals.* Talk presented at the 4th Annual Western Interdisciplinary Student Symposium on Language Research, London, Ontario, Canada.

Ando, E., Jared, D., Hino, Y., Nakayama, M., & Ida, K. (2012, February). *Interlingual phonological priming in Japanese-English bilinguals.* Poster presented at the 41st Annual meeting of Lake Ontario Visionary Establishment Meeting of Minds, Niagara Falls, Ontario, Canada.

PROFESSIONAL EXPERIENCE

2017-2018: Course Instructor, Department of Psychology, University of Western Ontario.

2010-2017: Graduate Teaching Assistant, Department of Psychology, University of Western Ontario.

PROFESSIONAL SERVICE

Reviewer for *Bilingualism: Language and Cognition*

AWARDS

2010 to 2016 Western Graduate Research Scholarship