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Research Article

Neurophysiological indices of the effect of cognates on vowel perception in late Spanish-English bilinguals

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ABSTRACT

It is well established that acquiring a second language (L2) later in life results in less accurate production and perception of speech sounds in the L2. An interesting question is to what extent phonological similarity of translation equivalents across the first language (L1) and L2 affects speech-sound processing and lexical access in an L2.

The present study examined this question by comparing processing of Spanish-English translation equivalents that either were phonologically similar (cognates) or dissimilar (non-cognates) in fifteen monolingual English-speakers and 15 late Spanish-English bilinguals. Event related potentials (ERP) were used to examine whether late L2-learners had more difficulty discriminating mispronunciations of vowels in English words that have Spanish cognates compared to words that do not have cognates. Behavioral results indicated effects of language background and cognate status on discrimination, with bilinguals showing poorer discrimination of English vowel mispronunciations than the American-English monolingual control group. ERP results revealed that cognate words facilitated L2 phonological processing as evidenced by a larger frontal positive component (P400) ERP effect, similar in amplitude to the P400 from monolinguals. Results suggest that cognate words facilitate speech processing in adult L2 learners, and, thus, may also be useful as a tool for perceptual learning of L2 phonology.

1. Introduction

Considerable research has demonstrated that attainment of native-like perception of second-language (L2) phonology is uncommon in adult learners of a second language (Flege, Munro, & MacKay, 1995; Levy, 2009; Oyama, 1976; Peltola et al., 2003). Perceptual abilities for L2 speech contrasts can be partially predicted from the relationship of the L1 and L2 phonological systems and their specific phonetic details (Best & Tyler, 2007; Bohn, Best, Avesani, & Vayra, 2011). However, these phonological relationships may not fully account for L2 perception patterns (Bohn et al., 2011). For example, a goal of the L2 learner is to recover meaning of L2 lexical (and syntactic) forms. Lexical processing is known to affect speech perception in the native language (Ganong, 1980). Thus, it is important to understand L2 speech perception in the context of lexical processing and to incorporate such factors into models of speech perception.

This study examines whether the phonological relationship between translation equivalents (cognates versus non-cognates) modulates late learners' speech perception of vowel contrasts that are not phonemic in the first language (L1). This is of theoretical interest in that it addresses to what extent L1 lexical knowledge can modulate phonetic perception of L2 lexical forms. More specifically, it addresses whether L1 lexical forms that are phonologically similar to translation equivalents have a facilitative or inhibitory effect on L2 speech perception. An additional question is whether neural correlates of phonetic and phonological processing of L2 lexical forms can provide insight on the processes leading to the behavioral response used to evaluate speech perception.

1.1. L2 speech perception

Considerable research has focused on explaining and predicting which L2 speech contrasts will be difficult for naïve,

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non-native listeners or for L2 learners (Best & Tyler, 2007). The Perceptual Assimilation Model-L2 (PAM-L2; Best & Tyler, 2007, extension of PAM, Best, 1995), the Second Language Linguistic Perception model (L2LP; Escudero, 2005) and Flege's Speech-Learning Model (SLM; Flege, 1995) are a few theoretical frameworks used to predict L2 speech perception.

The SLM (Flege, 1995) makes predictions regarding the learnability of single sounds based on the learners' L1 and age of acquisition. It predicts that learners will have the most difficulty forming new categories for sounds in the L2 that have a highly similar counterpart in their L1 and the difficulty increases with age. The PAM-L2 (Best & Tyler, 2007) and L2LP model (Escudero, 2005) focus on perception of sound contrasts in the L2 and predict poor discrimination of two L2 speech sounds that are assimilated into the same L1 phonetic category, with the L2LP referring to this as the new scenario. PAM-L2 provides more fine-grained predictions regarding non-native speech perception in terms of assimilation patterns into the L1, whereas SLM focuses more on how age of acquisition and amount of experience and use affect L2 production. However, there is great variation in the proficiency achievements of adult L2 learners, indicating that other factors need to be considered to more accurately model L2 speech perception.

A fourth model, the Automatic Selective Perception (ASP) model makes explicit the expectation that factors other than the relationship between L1 and L2 will influence L2 speech perception performance. This model was developed to account for differences in performance related to tasks and stimulus factors (Strange, 2011; Strange & Shafer, 2008). The ASP model posits that native-language speech perception is an involuntary process, whereby listeners use Selective Perceptual Routines (SPRs) to automatically select the most relevant phonetic features. These SPRs reflect language-specific weightings of relevant features that allow for the recovery of phoneme identity. The ASP model predicts that L2 speech contrasts that are not clearly distinct in the L1 will need attentional resources for robust L2 speech perception. Thus, as task difficulty increases, as in perception of connected speech or speech perception in noisy situations, L2 perception becomes more difficult because L2 listeners will fall back on L1 SPRs.

1.2. Lexical access in second language speakers

Similarities in L1 and L2 lexical items can facilitate L2 acquisition (Dijkstra, Grainger, & van Heuven, 1999). In particular, phonological similarity of an L1 word and an L2 word that share similar meanings can have a positive effect on L2 learning and processing. Words that have a shared meaning and origin and similar phonology across the L1 and L2 are called cognates. For example, English *elephant* and its Spanish equivalent, *elefante* are cognates. These words are characterized by similar speech sounds at a phonological level (and, indeed, have the same Latin origin), even though they differ somewhat in syllable structure and phonetic detail. Late L2 learners (i.e., those learning a language after puberty) demonstrate a higher level of proficiency for L2 words that have L1 cognates (de Bleser et al., 2003; de Groot & Nas, 1991). These L2 cognate words show facilitated lexical processing for the L2 learner, seen as more rapid access to word meaning; both semantic similarity and phonological similarity between L1 and L2 words show a benefit (Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010; Dijkstra et al., 1999; Gollan & Acenas, 2004). One suggestion regarding the representation of L1 and L2 cognate pairs is that they share more connections at both the lexical and phonological levels (Costa, Santesteban, & Caño, 2005). Despite the facilitation in access to lexical meaning, cognates pose particular challenges for L2 learners with regard to accurate pronunciation (Derwing, 2003). Specifically, several studies have shown less accurate production of cognate than non-cognate L2 words (Amengual, 2012; Nip & Blumenfeld, 2015).

It is also important to recognize that successful lexical access requires somehow suppressing or inhibiting the non-target lexical item. Studies have found that bilinguals access both of their languages during the lexical access process (Dijkstra & Van Heuven, 1998; Dijkstra et al., 1999), but at some point in processing, non-target words need to be inhibited (or the target item needs to accrue above-threshold level activation). Green (1998) proposed an inhibitory control model (ICM) that assists the individual in inhibiting activation of words in the non-target language in a reactive manner. In the ICM, words in the non-target language require a higher level of activation because the threshold is set higher by a mechanism outside the lexical selection process.

The ICM does not propose an account of lexical access with regards to cognate words. Cognate words show greater facilitation than non-cognate words (which show limited facilitation effects) in cross-language priming tasks (Sánchez-Casas, Davis, & Garcia-Albea, 1992). Facilitation would result in greater activation for cognates due to phonological similarity, which would allow for reaching the threshold for lexical access more rapidly. Alternatively, cognate words in the non-target language may not be inhibited to the same extent as non-cognate words. For either explanation, the existence of an L1 cognate might cause interference for accessing the correct phonological and phonetic form in the L2. More specifically, failure to effectively inhibit L1 lexical items could result in perception or production of an L2 cognate in a more L1-like manner. Thus, in accessing English *elephant*, its Spanish translation *elefante* would be activated, and remain activated (and possibly be selected) because of strong connections between the L1 and L2 lexical entries. In this case, the selected lexical item might result in phonetic realizations that match the L1. In contrast, the English word *chair* and its Spanish equivalent *silla* would share connections only in terms of semantic (and syntactic) information; this would result in less interference from the L1 in selecting L2 *chair* because the Spanish translation equivalent, *silla*, can more easily be inhibited (or more easily be maintained at a higher threshold). The question here in relation to connectionist models such as the ICM is whether the phonological status of translation equivalents influences the lexical access process, either by influencing the activation level of the non-target lexical item, or, perhaps as a result of the L1 and L2 forms sharing a lexical entry.

1.2.1. Cross language effect in vowel perception

Languages vary in the size of the vowel inventory. Speakers of languages with smaller inventories (e.g., Spanish, which has