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The Effect of Native Language Transfer in Second Language Acquisition: Example of English Vowel Acquisition

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Abstract:

This paper places significant emphasis on the influence of native language transfer on English vowel acquisition and systematically reviews related studies. At the theoretical level, the continuous evolution of contrastive analysis hypotheses and other hypotheses has revealed the complex mechanism of native language transfer in the process of English vowel acquisition. Empirical studies show that learners from different native language backgrounds are affected by native language transfer in various ways in the perception and output of English vowels. Based on this, pedagogical insights such as acoustic feedback and tiered instruction are proposed to address the challenges posed by migration. However, existing studies suffer from sample limitations and insufficient consideration of social context. Future research can combine interdisciplinary approaches to explore the neural mechanisms in depth and expand the sample scope. Simultaneously, expanding the sample scope will make the research results more representative and applicable, thus providing more robust support for enhancing the quality of English vowel acquisition teaching and improving learners' language proficiency.

Keywords: native language transfer; English vowel acquisition; pedagogical insights; neural mechanisms; interdisciplinary approaches

1. Introduction

Second language acquisition of the phonological system, in particular, has become a pressing task for learners worldwide. Phonology is the basis of learning a language and the basis for communicative application of a language [1]. However, at the same time, it is more complex and difficult than other aspects. Of the various variables that contribute to this complex process, the learner's knowledge of their native language is particularly vital, an effect known as native language transfer, which also forms the basis for second language acquisition theory. The transfer effect is bidirectional; it can be either positive, facilitating second language learning, or negative, leading to persistent errors. Migration occurs at all

language levels, but it is especially mentioned at the level of phonological acquisition. Vowels are among the most researched areas here because they are difficult to master and are most susceptible to the influence of the mother tongue. The English vowel system consists of a complex collection of phonemes, involving elongated, contrastive, and dynamic diphthongs, which pose unique challenges to learners' perception and production. Given the diversity of global languages, this system often differs significantly from the learner's native phonology, making it ideal for investigating the effects of mother-tongue transfer.

Vigorous research has systematically specified how speech sound perception and production, mediated by speech, are categorized in terms of mother tongue phonology, and has documented representative patterns of error associated with specific mother tongue environments. The majority of learners of near-phonemic opposites will find it very difficult to master this pair of vowels. This suggests there are opportunities as well as difficulties in this regard. However, the literature remains patchy, with studies having been carried out on pair comparisons of some native and target language pairs or single vowel investigations, thus not revealing sufficiently the total pattern of vowel migration across learner groups. Furthermore, the extremely high homogeneity of the methodology can interfere with the ability to evaluate the effect of native language migration on phonological system acquisition from a multicomponent perspective. The dynamic nature of the migration effect as a function of language level, its subtle effect on vowel-specific acoustic parameters (e.g., diphthong resonance peak trajectories), and the integration of recent neuroscientific findings on migration mechanisms need to be more strictly empirically examined.

Therefore, the objective of this review article is to synthesize and critically appraise the current research based on native language transfer in the specific area of English vowel acquisition.

2. Theoretical Basis and Historical Development of Native Language Transfer

2.1 Paradigm Evolution of the Contrastive Analysis Hypothesis and Error Analysis

It was in the 1950s that Lado formulated the contrastive analysis hypothesis, in which he posited that second language difficulty is determined by logically contrasting the differences in the structure of the phonology and syntax of the mother tongue (L1) and the target language (L2) [2]. Stockwell and Bowen also suggested a "hierarchical model of difficulty" to classify vowel differences [3]. For instance, Spanish /i/ and English /iː/ are quite similar, which is an "exact correspondence" case. Japanese /a/ and English /ʌ/ are not the same, but belong to the "partial overlap" group. Chinese has no /æ/ sound, so it is "zero correspondence". The model argues that of these cases, zero-corresponding vowel differences account for the strongest transfer effect in language learning as well as the most difficulty in learning. The model was an extension of CAH to the segment of the vowel. It was challenged, however, by Schachter [4].

He argued that the theory did not account for learners' strategic avoidance and did not consider very well the role of cognitive factors such as overgeneralization. This question led the academic community to begin paying attention to the subjective initiative and cognitive principles of individual learners, thus illuminating a new horizon for the research on second language acquisition. Then, scholars did error analysis to collect data and found that the language errors among students were not only caused by the target language structure and the native language structure, which refuted the CAH theory and brought the studies closer to the true nature of learning. As research progresses, native language transfer at the level of phonology has been an issue of concern, and James found that 62% of errors were phonological transfer errors, far higher than syntax (24%) and vocabulary (14%) [5]. This result not only leads the researchers to pay greater attention to the phenomenon of phonological transfer, but also makes the field significant in research concerning native language transfer.

2.2 Cognitive Modeling Innovations in Phonological Transfer

Flege's Speech Learning Model (SLM) remedies the limitations of traditional transfer theory by no longer considering native language impact to be a static one-way interference [6]. The crux of the model is uncovering the dynamic interaction mechanism between perceptual assimilation and phonological category restructuring. The successful attainment of bilingual vowels is not a matter of merely mechanical substitution of the native language categories, but concerns the way learners perceive and categorize cross-linguistic phonological contrast. When the learner discovers that a second-language sound is similar to one of the members of the category of the native language, the boundary of the native language's phonetic category automatically extends to include this approximation as a member of the current category. This brain's flexible processing avoids reconstruction of completely new categories and lowers cognitive load. In the case of a

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second language sound having no equivalent in the native language, expert training is required to create novel phonological categories, a process that illustrates the learner's active cognitive ability in phonological acquisition. Although SLM is not entirely explanatory for the contribution of social context to phonological learning, its category reorganization theory provides a theoretical account for the nonlinearity of second-language phonological acquisition.

The Perceptual Assimilation Model (PAM) of Best is another important model that breaks down cross-linguistic speech perception into a multidimensional categorization system, and the high level of fine-grained distinction among six assimilation modes has dual theoretical utility [7]. By distinguishing diverse mechanisms such as single-category assimilation and dual-category assimilation, the model deconstructs the hierarchy constraint effect of native speech categories on second language perception. Variation in the fineness of native language categories may lead to different sensitivities of the learners to the contrast of close sounds, i.e., learners with coarser phonetic categorization in the native language will have greater difficulty in perceiving fine distinctions of close sounds in the second language. In contrast, models such as non-native assimilation have been proposed to account for explanations of persistent bias in phonological acquisition on the perceptual level. Non-nativized assimilation is a cross-language speech perception model proposed by PAM that accounts for an instance where second language speech goes beyond the native language category network. The learner's established native language category network is the foundation for perception and speech comprehension, and when the second language speech exceeds this, it cannot be approximated with the mother tongue. Not only can the learner not perceive the difference in perception, but it is also difficult for the learner to learn the pronunciation in production. This is a cause for concern in second language speech acquisition. When the second language speech is completely outside the network of the native language, the ease of acquisition significantly dwindles, and such a form of speech has a tendency to compel learners to create new cognitive connections. It is to be noted that the PAM model's study of modulation of second-language experience on assimilation patterns is a demonstration of speech acquisition plasticity and is proposed to reflect an initial anchoring effect of native language category influence. While the strength of assimilation can become attenuated by experience accumulation, the native language perceptual base continues to provide a reference base for phonological processing of the second language.

In total, SLM and PAM build collectively a whole series of cross-linguistic phonology research from perception to category to acquisition. The latter focuses on dynamic mechanisms, and the former focuses on typological categorization, and they complement each other for a better acquaintance with the wealth of native language migration at the phonological level [6, 7]. This migration is not a simple negative intrusion or one-way facilitation, but rather an adaptive process of learning by the dynamic construction of perceptual cognition during the interactive process among the native language categories and the second language input. The deficiencies of these models may be the lack of depth in their explanation of neural operations, but they do present a theoretical framework for subsequent research on phonological acquisition alongside brain science.

3. The Complexity of the English Vowel System and Acquisition Challenges

3.1 Multidimensional Oppositional Features of the English Vowel Sound System

Received Pronunciation (Standard English) vowel system contains 12 monophthongs and 8 diphthongs, whose prominent features are four aspects: high-middle-low tongue height, front-central-back tongue position, rounding or spreading of rounded lips, and length or shortness of sound length [8]. As with that little contrast between /iː/ (high front spreading lip long vowels) and /ɪ/ (high middle front spreading lip short vowels) relying on microdifferences concerning sound length and tongue height, sound length is the unit of measurement of the duration of sound, relying on the extent of time during which the vibrations of the articulators continue. Duration of sound is the discriminator between /iː/ (high front labial spreading long vowels) and /ɪ/ (high middle front labial spreading short vowels), and it may change the perception of speech as well as meaning. When /iː/ is pronounced with a high and front tongue position, the articulatory organs are tense and the sound length is longer, while when /ɪ/ is pronounced with a slightly lower back tongue position, the articulatory organs are less tense and the sound length is much shorter. This small difference in the position of the tongue affects the status of the articulatory organs, and if not explained clearly, will result in mispronunciation and affect communication. This is extremely hard for native speakers lacking a sound length opposition (e.g., Spanish natives, Chinese natives). This is one of the proving grounds of the phenomenon of negative transfer, and studies in this area are promising. For example, English diphthongs such as /aɪ/ (gliding from high front to low front vowel) require a

dynamic tuning action, which, unlike Chinese compound rhymes, involves a great discrepancy of movement path.

Acoustic analysis also shows that native English speakers have large discrete vowel spaces and more contrasts in articulatory locations for the production of different vowels. The monophthong F1 and F2 distribution in native speakers of English has a varying standard deviation from non-native speakers [9]. Additionally, variation in dialect also affects the difficulty of acquisition, so that the case becomes more complex.

A comparative study of British and American English revealed that American nasal consonants are synergistically articulated to a greater degree, thereby posing difficulty in vowel identification, and British nasal consonants tend more towards incorrect identification, considering the difference in the perception of vowels between the two [10].

3.2 Empirical Evidence of Cross-Language Migration

Chen investigated the English vowels /i/ and /ɪ/'s phonological transfer with Vanya, a high-level Chinese-speaking English learner [11]. Two perception tests and one pronunciation test were included in the experiment, and data from the perception tests showed that Vanya's discrimination accuracy between /i/ and /ɪ/ was as high as 100%, indicating that she had the ability to effectively identify the vowels at the level of phonological perception. But according to the acoustic analysis of the pronunciation test, the values of English /i/ first resonance peak (F1) and second resonance peak (F2) are close to and lower than native Chinese /i/ standard values, and the F2 value difference is particularly significant, which shows that Vanya pronounces English /i/ with a more posterior tongue position than English native speakers, and shows that the native phonological areas significantly interferes with the bilingual pronunciation of English /i/ and the F2 value of /ɪ/ is below the standard value of American English. The F2 value of /ɪ/ is also lower than that of American English standard, which shows that mother tongue's impact on bilingual phonological output may be extended to the same phonological domains, which means even if advanced learners have good phonological perception ability, mother tongue phonological transfer will still be shown in pronunciation through acoustic properties, and it is difficult to cut off the deeper influence of mother tongue domains by perceptual training only, and that the /i/ sound is 0.3 dB and 1.5 dB ahead of the standard pronunciation. In addition, the /i/ sound of Mandarin is 0.3 dB louder than regular pronunciation and is shifted forward by 1.5 to 2 millimeters, altering the perception of the English /iː/ sound [12].

Cantonese has a complex system of vowels, which is generally counted as 9 vowels and 8 diphthongs. Munro study targeted the language transfer phenomenon of English acquisition of Cantonese native speakers' tight/relaxed high vowels (/i, ɪ, u, ʊ/) and reported that Cantonese lacks /ɪ/ and /ʊ/ since the most problematic one is negative transfer (intelligibility 51%, 59%) [13]. And the positive transfer facilitating effect by the similarity of /i/ and /u/ was diminished by the rhyme-final context (e.g., /uk/ intelligible only 33%, with huge individual differences. 59%), the facilitative transfer effect of the parallel /i/ and /u/ was hampered by rhyme-final context (e.g., /uk/ could be understood as little as 33%), and large individual differences existed, the ease of different words with the same rhyme-final (e.g., kid vs. lid) was highly varied, and the length of residence (LOR) and the percentage of English use (% USE) could not explain the individual variation, which contradicts the generalizability prediction of the Comparative Analysis Hypothesis (CAH), which suggests that language transfer can occur when Cantonese is not spoken.

This study contradicts the CAH generalizability predictability, which states that language transfer is determined by various factors such as phonemic categories, rhyme-final synergies, and lexical attributes and that instructions should deviate from pre-established difficulty hierarchies based on mother tongue and move towards technology-aided personalized pronunciation assessment.

4. The Specific Performance of Native Language Transfer in English Vowel Acquisition

4.1 Differentiation of Native Language Transfer Effects of Perception-output Correlations

Cho and his colleagues conducted an empirical study with Korean English learners in the UK, who were divided into experienced and inexperienced groups according to their age of arrival and length of residence, a division that effectively captured the difference between the degrees of integration of the learners in the second language community [14]. The study illustrates the differentiated mechanism of native language transfer in English vowel acquisition.

The results of the study have important theoretical implications inasmuch as substantial perception-output correlations for vowels emerged only for the experienced group, a trend that may indicate that learners increasingly create stronger perceptual-output links in phonological processing with more experience in second language acquisition.

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Closer inspection showed that there was a significant positive correlation between perception and output for English vowels similar to Korean vowels only for /i/, and a negative correlation between perception and output for vowels very dissimilar from Korean vowels only for /ɑ/. This result shows that the native language transfer effect on L2 vowel learning is not a monolithic pattern, but rather demonstrates a dynamic differentiation of the perception-output relationship at the phonological processing level with more learning experience, providing empirical evidence of the experience-dependence of native language transfer in phonological learning.

4.2 Impeding Effects of Negative Migration

Negative native language migration is a common and strong pattern in English vowel learning, and learners with different native languages have different issues. Park examined Korean learners' English vowel sound quality, duration ratios, and resonance peak values in a sample of English speech and found that Korean learners did not weaken the vowels in English non-stressed syllables but rather assimilated them to corresponding ones in their own vowel stock and pronounced them as full vowels, thereby highlighting the negative migration in vowel weakening in syllable-timed to stress-timed languages [15].

Almoabdi and Rahaf have conducted a study on ESL students at the University of Jeddah, Saudi Arabia, and concluded that native Arabic speakers were experiencing difficulty in perceiving vowels while reading English texts, which might be the outcome of disparity between first and second language linguistic systems or negative transfer of the first language processing program to the second language processing [16]. The study also noted that gender played no significant part in vowel blindness, and both male and female learners were at a disadvantage in terms of processing short vowels, whereas males were in trouble with processing long vowels.

In conclusion, the processes and expressions of negative transfer impacting the acquisition of English vowels by learners from different native language backgrounds are distinctive. An extensive examination of these negative transfer phenomena can help to provide targeted strategies for English instruction and promote learners' English vowel acquisition.

5. Instructional Insights and Intervention Strategies

5.1 Acoustic Feedback Based Instant Correction Technique

Acoustic feedback technology has immense value in English speech pedagogy, which is capable of helping educators conquer students' pronunciation challenges with high precision and helping students advance their level of pronunciation. The commonly used varieties of acoustic feedback technology abound in applications and exhibit diverse advantages and features in real teaching.

Praat, a software for real-time speech visualization, can show in real time peaks of resonance (F1/F2), fundamental frequency (F0), and pitch length of speech sounds. According to such visualization information, teachers can directly understand weak pronunciation points of students and maximize the teaching timetable; for learners, it is also easy to assist them in understanding the relationship between acoustic features and articulatory movements and thus learn and master better the right pronunciation at a deeper level.

Audio-visual high-variable phonological training can also be applicable in practice teaching. The Chinese English graduate experiment by Li proved that the training method effectively improved the precision of learners' pronunciation of English interdental sounds /θ, ð/, but only had minimal improvement in the vowel /ɪ/ [17]. This finding shows that the training method is effective in training specific consonants, but the degree to which it is effective in vowel teaching needs to be further studied.

In addition, the newly developed Intelligent Speech Training System is also worth mentioning. The system can automatically identify vowel errors on the basis of advanced speech analysis technology and provide targeted practice solutions. Its greatest benefit is the planning of personalized learning paths -- the system can adaptively adjust training content according to the real-time performance of learners, thus improving the quality of vowel pronunciation and providing learners with the convenience of independent training assistance.

Overall, these acoustic feedback technologies facilitate English speech teaching with diverse means: speech visualization tools enable accurate diagnosis, audiovisual training is effective in educating specific phonemes, and intelligent training systems optimize learning efficiency with customized programs. Nevertheless, there are still shortcomings in the application of the currently existing technologies, for instance, the insufficient effect of audio-visual training on the improvement of learning in certain vowels. In the future, if we are able to coordinate further the advantages of various technologies and make the most of the versatility of teaching devices, it will better meet the real needs of English speech teaching.

5.2 Individual Difference-based Tiered Instruction

Linguistic energy and working memory capacity play an important role in English vowel acquisition transfer plasticity. Sun and Li noted that big data and artificial intelligence technology are deeply affecting English language teaching and disrupting the balance of the initial English language teaching ecosystem [18].

The study introduces artificial intelligence and big data into English teaching and calls for the building of a new ecological environment for teaching. On this basis, the study systematically analyzes the characteristics of English teaching in the big data environment and advocates the building of a new English teaching ecosystem with the support of big data technology to improve teaching and learning quality. Learners with different levels of proficiency differ in vowel acquisition and transfer skill, and can rely on the information sharing, high-quality teaching materials, and personalized learning support provided by this ecological setting to maximize their learning achievements. Low-level learners can benefit from big data analysis to identify their learning problems and have focused training programs designed, whereas high-level learners can receive more advanced support from individualized learning programs.

Apart from that, instructors can investigate the relationship between numerous variables in English student learning by using data mining technology to identify pronunciation problems accurately. Big data technology provides tremendous help in personalized English vowel learning diagnosis. On the basis of a huge majority of learners' speech databases, the model of the machine can make accurate predictions regarding the typical pronunciation deviation patterns of learners with some native language backgrounds and provide preventive training modules accordingly to help learners counteract the interference of the negative transfer of the native language.

6. Controversies and Future Research Directions

6.1 Neuroplasticity Limits of Native Language Transfer

The limits of neuroplasticity in first language learning are a major area of study within the field of language acquisition. Højlund and his colleagues conducted a 19-month follow-up experiment on two cohorts of Arabic and Dari language officer trainees, and found that, although no language-specific effects of learning on the trainees' mismatched negative waves (MMN) were found in this experiment, persistent MMN responses were recorded in most of the measurement sessions, and some response patterns showed dynamic changes across learning time [19]. Although no language-specific learning effects on the cadets' MMN were observed from the experiment, consistent MMN responses were achieved in most measurement sessions and some of the response patterns dynamically changed over the learning process, which implies that there exist neural adaptations in foreign language learning.

For future direction of follow-up research, to begin with, the sampling scope can be further broadened to include learners of other languages and diverse backgrounds in an attempt to examine the generalizability of the current findings. In the meantime, other neuroimaging techniques, such as functional magnetic resonance imaging (fMRI), can be combined to reveal the mechanism of neural activity modulation in foreign language learning from a multivariate perspective. In addition, longer-term tracking experiments to observe the dynamic evolution of neuroplasticity in multiple stages and learning environments can provide more specialized references to language teaching. It is worth noticing that as of now, the technology is not yet capable of assessing whether some migration phenomena are desirable or not, and this line of research might become a crucial breaking point for further studies.

6.2 The Integrating Role of Other Disciplines

Chen and his colleagues developed a new paradigm of neural speech decoding with deep learning [20]. This research result not only has extensive application prospects in brain-computer interface technology, but also brings new conceptions to language transfer studies. The architecture involves an electrocorticographic decoder to transduce electrocorticogram (ECoG) signals to interpretable speech parameters and a differentiable speech synthesizer to convert speech parameters to acoustic spectrograms, facilitating natural and highly reproducible speech generation. This demonstrates the powerful ability of deep learning to process sophisticated speech signals and reveal the speech generation mechanism, providing more accurate instruments and methodologies for language transfer studies.

Therefore, the interdisciplinary blending of L2 learning phonological transfer with other disciplines is indeed a research direction with rich potentiality and prospect, foreseen to bring new analytical perspective and breakthrough development into L2 learning research.

7. Conclusion

This paper deals with the native language transfer effect

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on English vowel acquisition. Theoretically, the continuous development of theories such as the contrastive analysis hypothesis and the phonology learning model has further revealed the sophistication of native language transfer at the phonological level. It has been shown through empirical studies that the phonological input and output of learners from various native language backgrounds are affected differently. In practice instruction, immediate correction methods based on acoustic feedback and layered teaching methods based on individual differences have also been of the utmost significance.

However, there are still some defects in the current study, e.g., the relatively limited scope of the research sample and the insufficient consideration of social contextual factors. Follow-up studies should further expand the sample coverage, combine multidisciplinary technical means, and investigate in-depth the neural mechanism of the brain, which has significant practical value for improving the quality of English teaching and the language capacity of individuals.

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