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A Review of Research on Supersegmental Acquisition in Trilingual Learners Abroad and Its Implications for Research on Supersegmental Acquisition in Trilingual Learners in China

Yuli Chen

Southwest Minzu University, Chengdu, Sichuan, China

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Abstract: As research into multilingual acquisition advances, phonological acquisition has become the crucial point of study. However, systematic research on suprasegmental features in trilingual acquisition remains limited. Suprasegmental features not only carry linguistic rhythm and semantic decoding roles but also significantly influence the naturalness of language production and comprehension efficiency. This paper focuses on phonological acquisition research in the field of multilingual acquisition, systematically reviewing theoretical models and methodological approaches in foreign studies on trilingual suprasegmental acquisition. It analyses cross-linguistic transfer mechanisms and influencing factors. By systematically organising international research frameworks and methodologies, this paper aims to provide theoretical frameworks and methodological insights for trilingual suprasegmental acquisition research in China, thereby promoting the development of related research in the country.

1. Introduction

As global language contact deepens, multilingualism has become an essential skill in contemporary society. Approximately 43% of the worldwide population possesses bilingual or multilingual abilities[1]. China boasts significant linguistic diversity, with around 284 languages spoken. In this context, research on trilingual acquisition holds substantial social and academic value for China. However, current studies on multilingual phonological acquisition primarily focus on segmental features, with insufficient attention given to the acquisition mechanisms of suprasegmental features. Suprasegmental features, as an integral part of linguistic rhythm, stress, and intonation, play an irreplaceable role in semantic understanding and pragmatic expression [2]. Compared to bilingual acquisition, the interaction between languages in trilingual acquisition is more complex.

Over the past few years, international academic circles have conducted increasingly in-depth research on trilingual phonological system acquisition, resulting in the emergence of numerous theoretical models, including dynamic systems theory , the cross-language transfer hypothesis , ADAPPT theory, the automatic selection perception model, and the contextual framework of the example model, among others. These theoretical models offer diverse perspectives for understanding the acquisition process of Trilingual suprasegmental features. By integrating the nonlinear and

dynamic characteristics of dynamic systems theory, the transfer pathways of the cross-language transfer hypothesis, the phonological restructuring of the phonetic learning model, the perceptual mechanisms of the second language perceptual assimilation model, the language system changes of the ADAPPT theory, the perceptual procedures of the automatic selection perception model, and the example activation of the example model's situational framework, we can comprehensively explain the complex phenomena observed in trilingual learners when perceiving and producing suprasegmental features. Future research should more precisely integrate these theories to explore the specific mechanisms of trilingual acquisition under different language patterns and multilingual exposure contexts[3].

There are only a few studies on trilingual rhythm comparison in China, research on English education in a multilingual environment, and the influence of Chinese dialect prosody on trilingual stress production[4]. Compared to international research, domestic studies primarily focus on the outcomes of static transfer, with little attention given to the process of dynamic transfer. To address this research gap, this study focuses on two key areas: (1) explaining the acquisition pathways of Chinese learners using international theoretical models; and (2) drawing on international experience to optimise Trilingual suprasegmental teaching and assessment in China. This study aims to systematically review domestic and international research findings, analyse the transfer mechanisms of trilingual suprasegmental acquisition, and propose teaching recommendations tailored to the Chinese context, thereby promoting the development of multilingual education in China and enhancing learners' language proficiency and cross-cultural communication skills.

2. Theoretical Framework from an International Perspective

Amid trilingual acquisition research, the acquisition mechanisms of suprasegmental features are increasingly becoming a frontier in the field of multilingual acquisition. During language processing, suprasegmental and segmental-level phonemes collaborate to influence phoneme recognition, semantic comprehension, syntactic judgment, and discourse coherence construction. Compared to segmental features, suprasegmental systems are more vulnerable to interactions between multilingual systems, especially when trilingual learners meet the intertwining of multiple language experiences in L1, L2, and L3, resulting in more dynamic and complex acquisition pathways. Therefore, constructing a systematic theoretical framework to explain the acquisition process of suprasegmental dimensions in trilingual learners holds significant theoretical and practical implications. Current research in trilingual acquisition phonetics and phonology primarily focuses on expanding theoretical models that explain the perception and production of individual features in L1 and/or L2. These models are primarily composed of the following five theoretical frameworks.

First is the Dynamic Systems Theory model (DST). de Bot et al. (2007) state that language is a dynamic system composed of variables that evolve and interact over time, and language acquisition is an ongoing evolutionary process within this system. They emphasise that minor differences at the system's outset can have significant impacts on subsequent development, and that phonology, syntax, semantics, and other levels are interrelated and cannot be examined in isolation. Furthermore, as time passes, the system tends toward certain stable patterns. This theory posits that the phonological systems of L1/L2/L3 are nonlinear interactive subsystems, explaining the non-progressive nature of prosodic acquisition (e.g., initial advantages and later fluctuations) and the coupling with social contexts (e.g., Chinese cultural reinforcement of L1 transfer to Japanese L3) [5].

The cross-language transfer hypothesis, first proposed by Odlin, is an important concept in the field of second language acquisition. Odlin defines transfer as the influence resulting from the similarities and differences between the target language and any other previously acquired language (not fully mastered). Cenoz applied this theory to the study of trilingual phonological acquisition.

Subsequently, many scholars conducted further research based on this theory. Hammarberg & Hammarberg applied this theory to the study of trilingual suprasegmental acquisition, using a longitudinal case study method to track the trilingual acquisition (TLA) process of multilingual Sarah Williams (L1 English, L2 German, L3 Swedish). First, three native German speakers identified the native language background of Sarah's two L3 Swedish development stages (initial/advanced) based on recordings of the same text. Then, the researchers conducted a dual objective and subjective analysis of the speech samples. The study found that during the initial stage of L3 acquisition, Sarah's Swedish output exhibited significant L2 (German) accent features, leading to misidentification of her native language background. As her L3 proficiency improved, the phonetic interference from L2 (German) significantly diminished, while L1 (English) accent features gradually dominated her L3 output, enabling accurate identification of her native language background[6-8].

The ADAPT theory specifically explains the mutual nature of cross-linguistic influence at the phonetic level in bilinguals, positing that L1 is always influenced by exposure to and acquisition of L2. Under specific exposure conditions and experimentally induced language patterns, both short-term and long-term changes may occur [9]. In other words, L1 and L2 exhibit variability at any stage of an individual's lifespan, challenging the "critical period constraint" assumption of traditional models such as PAM-L2/L2LP/SLM. Furthermore, all levels of the L1/L2 phonological system may change, including: segmental features, suprasegmental contrasts, and phonological processes. Helms conducted research finding that the first language system is not fixed but is influenced by subsequent language learning (the existence of reverse transfer), and the effects of reverse transfer and language experience can manifest in both production and perception.

The Automatic Selection Perception Model (ASP) posits that L1 listeners develop specific perception protocols to achieve efficient automated processing of their native language. Chan & Chang further tested the ASP using a trilingual tone perception experiment. To investigate acquisition order and cross-language similarity, researchers recruited two types of Chinese-English bilinguals (i.e., L1 Chinese-L2 English speakers and L1 English-L2 Chinese speakers) and bilinguals with English as L1 and a non-tonal language as L2. Tone perception accuracy and reaction time were measured using discrimination tasks and similarity rating tasks. The findings revealed that bilinguals with Chinese as their L1 demonstrated significantly higher perception accuracy than those with Chinese as their L2; bilinguals with Chinese as their L2 showed marginally higher perception accuracy than those with a non-tonal language as their L2. This result aligns with the predictions of the ASP model—bilinguals with Chinese as their L1 exhibit superior performance in three-language tone perception due to their heightened sensitivity to pitch cues associated with Chinese tones.

The Exemplar Model of Language Use and Cognitive Representation offers a new view on explaining the non-selective nature of language activation. In the speaker-listener cognitive process, "all phonetic variants of a word are stored in memory and form a chunk: prototypes with higher similarity are closer together, and high-frequency prototypes are stored more firmly than low-frequency ones"[10-14]. Analogous to language models based on usage, it was found that cognate representations can be stored in the same word cloud, allowing cognate orthographic, phonetic, and semantic representations to influence production in another language. Based on the same basic principles, this model can also be extended to trilingual phonological acquisition[15-17].

3. Main characteristics of research abroad

3.1 Theoretical models in foreign research are diverse and integrated, with a focus on migration dynamics

In recent years, research on trilingual acquisition abroad has moved beyond a single theoretical perspective, instead tending to integrate the previously mentioned models to comprehensively track

the multidimensional dynamic processes of suprasegmental acquisition. Researchers often test the nonlinear fluctuations of DST, the positive and negative effects of cross-linguistic transfer, the perceptual habituation of ASP, and the plasticity hypothesis of ADAPPT within the same experiment, while combining the Usage-Based paradigm to assess the depth of memory for high-frequency prosodic prototypes. Through multi-model comparisons and mixed-effects statistics, researchers can reveal how individual differences vary with input types and task requirements, as well as effectively identify the complementary and conflicting aspects of different models, providing more operationally feasible theoretical support for trilingual prosody instruction design[17-20].

3.2 Research methods and techniques used in foreign studies are diverse, with studies typically involving longitudinal tracking and multimodal presentation of research data

In recent years, research on trilingual suprasegmental acquisition abroad has shown the following methodological innovations: first, acoustic analysis tools and dynamic curve modelling have been widely used. Wang utilized Praat to extract duration, mean pitch, and intensity parameters, and combined functional data analysis (FDA) to characterize the dynamic patterns of intonation curves, revealing rhythmic differences between children with autism spectrum disorder and typical children in focal marking; Qin captured instantaneous pitch information using a 500 ms stimulus interval in an AXB discrimination task, and employed a linear mixed-effects model (LMM) to control for individual and trial variability, validating the interactive effects of L1 dialect and L2 proficiency on Cantonese tone perception. Second, designs combining longitudinal and cross-sectional approaches continue to advance research on acquisition trajectories[21-24]. Onishi conducted a longitudinal examination of the accent-fluency relationship among English-Japanese trilingual learners through a reading task with balanced vocabulary difficulty; Nelson measured perceptual accuracy and reaction time using an ABX task in four follow-up tests at 1, 3, 5, and 10 months, outlining the perceptual development curves of adolescent and adult L3 learners. Finally, statistical analysis frameworks have become increasingly diverse: from the earliest paired and independent samples t-tests , to d′ values and Cohen's d, mixed-effects models , and even principal component analysis and hierarchical comparison analysis, researchers have continuously introduced more rigorous tools to quantify transfer effects, group differences, and individual plasticity[25-28].

4. Conclusion

Based on the aforementioned international research findings, domestic research on trilingual suprasegmental acquisition can be conducted from the following four aspects: First, the construction of a customised theoretical framework. Building upon established frameworks such as the Dynamic Systems Theory, the Cross-Language Transfer Hypothesis, the ADAPPT Bidirectional Plasticity Model, the automatic selection perception model, and other established frameworks, a cross-linguistic prosodic transfer model suitable for the "dialect–Mandarin–foreign language" trilingual context should be proposed, focusing on elucidating the functional conflicts and complementary mechanisms between pitch trajectories, stress positions, and sentence intonation types. Second, multimodal and refined experimental techniques. To fill the technical gap in domestic research on speech perception and production mechanisms, it is recommended to introduce multimodal methods such as ERP, functional data analysis (FDA), automatic prosody annotation, and speech synthesis to construct a closed-loop experimental paradigm from perception to production; and to quantify transfer effects and individual differences using statistical methods such as linear mixed-effects models. Third, sample diversity and language combination expansion. The scope of research subjects and language types should be expanded, such as selecting learners from various dialect backgrounds in Southwest and Northwest China, and examining the suprasegmental acquisition trajectories of different

trilingual combinations such as “dialect-Mandarin-English/Japanese/French” to enhance the external validity and practical value of research conclusions. Fourth, interdisciplinary integration of cognitive and social factors. Psychological and social variables such as language attitude, cross-cultural anxiety, and metalinguistic awareness should be incorporated into experimental designs to explore how these factors modulate transfer pathways and prosodic processing efficiency. These findings should be combined with educational and psychological methodologies to develop prosodic assessment tools and training programs tailored to the Chinese context.

Trilingual suprasegmental acquisition is an important component of multilingual research. While international research has reached a relatively mature stage in terms of theory and methodology, domestic research is still in its infancy. By drawing on international research findings and integrating China's multilingual context and technological advancements, future efforts aim to achieve breakthroughs in both theoretical development and practical applications, thereby advancing the quality of multilingual education in China.

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