DOMINATION OF PHONOLOGICAL CODING SYSTEM OF L1 OVER L2 IN DUAL CODING THEORY

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Abstract

The issue concerning whether the speech sound in bilingualism is activated by one system or two systems of different languages simultaneously requires further evidence. Thus, this study attempted to prove the dominance of sound systems across English and Balinese from the perspective of dual coding theory. This study applied a qualitative approach that describes the English speech of Balinese speaking students presented in the form of a segmental category. *This study involved 76 students of English in Denpasar as respondents. The instruments were in the form of 65 English words list, picture lists, and 10 sentences. The phonetic features including formant value and voiced onset time (VOT) were analyzed by PRAAT*. Each data were classified using the articulatory phonetic and referential technique. The study revealed that the students tended to activate the system of L2 independently but arrived at the phonetic realization of L1. The mental sound process occurs from coding, retrieval, and phonetic implementation. Balinese speaking students in articulating English activate L1 and L2. However, the phonetic implementation can be purely L2, mixed L1 and L2, or just purely L1. This tendency depends upon students' phonological awareness, learning experience, or their daily practice. This study suggests that the four levels of students' English articulation involve transmission, perception, phonological process, and phonetic realization. The activation of the sound system of L1 into L2 occurs in the perception level. *This study suggests that the learners and teachers of English in Bali should adopt explicit learning to minimize the influence of L1 on L2*

Keywords - *phonetic representation, coding system, bilingual learning*

Introduction

Incorrect English pronunciation by students of all education levels in Bali does not seem a prominent and unique issue to investigate because the errors are assumed by some scholars to be a natural process in bilingual learning and do not require any further debate. However, exploring the investigation of language sound processing does not only overview the natural truth of sounds but also provides a scientific vision about mental sound analysis. English and Balinese language sounds have a relatively identic articulation mechanism. However, some consonants such as /ʃ/, /ʧ/, /f/, and /v/ or consonant cluster /sp/ do not correspond with Balinese orthography. The structure of the English sound unit violates the consistency of orthography. In English, orthography is not the phonetic realization of the language because the relation of words and sounds is not always symmetric (Polinsky & Scontras, 2019). Harley (2001) states that English printed letters do not always correspond to specific sounds and vice versa. The letter "o" represents several different sounds (such as in the words "mock", "moon", and "mow").

Inconsistency between English orthography and its phonetic realization makes the Balinese students feel confused. Coding the speech sound may involve sound transmission, perception, mental phonology, and realization. The information from letters and speech sounds come from visual and auditory sensory. Furthermore, the system activates the coding system of

two different languages through the interpretation of word sound and meaning. In bilingual learning, the coding sounds come from the dual language system; mother language (L1) and target language (L2). In the coding process, the separation of two language systems controls the mental process of sound from the underlying form into deriving form employing sound alteration and representation (Adnyani & Pastika, 2016). The final stage of coding the written symbols is the phonetic realization that covers two sound language systems (Clark & Paivio, 1991).

The phenomenon of incorrect English pronunciation by foreign students refers to linguistic, psycholinguistic, or neuro-linguistic concerns (Amengual & Simonet (2019); Adnyani et al., (2018); Buckingham & Christman (2008). Vihman (2002) suggested that incorrect pronunciation of L2 by the speaker of L1 reveals from the influence of L1, learning experience, and habit formation as part of explicit learning 'direct learning'. Indirect learning means the knowledge of language sound structure is from unconscious learning since the baby is in the womb (Vihman, 2002). Furthermore, Simonet (2016)states that conception and experience enable language learners to produce closely native-like pronunciation. However, amongst foreign language research findings and learning models, the emphasis on sound coding systems in bilingual learning of English by Balinese students requires more empirical studies and scientific evidence.

From the language learning point of view, phonological awareness and habit formation may result in the appropriate English pronunciation (Wardana, 2014). Phonological awareness is crucial for constructing conceptual sounds, so the students recognize the sound system of the target language. Explicit learning may contribute a big impact on sound pattern formation. So, the activation of L2 achieves accurate goals. Balancing the interference of L1 on L2 requires a learning strategy. Phonological awareness may enable students to identify, differentiate, and implement phonetic realization correctly (Galles & Bosch, 2005). The physiology of articulation should be at an earlier age before the sound physiology of L1 does not dominate (Simonet, 2016). By communication habit formation, the movement of articulators seems unconsciously natural as L2.

Considering the phenomenon, this study aims to describe any types of English phonological alteration errors produced by Balinese students. Furthermore, this study examines the interference of the sound systems of L1 and L2 in bilingual learning. The third objective of the study is to describe how the dual coding theory examines the domination of the L1 sound system over L2 word sound processing. The role of dual coding theory describes the dominance of two different language systems. The combination of phonological theory and bilingual learning theory as the basic concept of dual coding theory may provide evidence of existing articulation phenomena of English by Balinese students. The phonological theory describes the articulatory phenomenon of both languages (Schane, 1973). Meanwhile, the dual coding theory may provide information on how the sound system activates L1 into L2 simultaneously, so the effective strategy in bilingual learning may result in better achievement.

Methods
Sample

The study was carried out in May 2021. It involved EFL university-level EFL students in Denpasar from three different universities. The population was 95 students who have been learning English since they were 9-years old. The determination of sample amount referred to the Slovin model with *a margin of error* was 5% or 0,05 (Bungin, 2003). Therefore, the samples were 76 students that were purposively gathered. The sample consisted of 25 or 33% boys and 51 or 67% girls. Where 20 students were the age of 18 or 19 years old, 37 students were the age of 20 or 21, and 19 students were at the age of 22 or 23. The sample was considered representative enough.

Instruments

The instruments that were utilized to collect the primary data in this study were sixty English word and pictures lists and ten sentences. The students read the words and those sentences and recorded them with a sonny sound recorder. The words, word pictures, and the sentences were constructed containing consonants, consonant clusters, vowels, and diphthongs in different distributions; in initial, media, and final positions. The student's sound recordings were gathered and classified into types of distortion, segmental alteration, and four factors of misrepresented articulation. All the instruments were validated by expert judges in phoneticians, linguists, and language lecturers. To measure the accurateness of the English sounds production of the students, the acoustic features of the sound recordings were analyzed using PRAAT (Boersma, 2021) to recognize if there were any sound distortion, sound alteration errors, and VOT for aspirated plosive consonants.

Data collection procedures

The data were analyzed and presented considering the objective of the study, questions of the study, and characteristics of the research approach. The first objective was to describe the level and types of phonological alteration and factors that caused the phonological distortion and alteration. So, all the errors were calculated in form of a percentage, the distribution was tabulated, and the results were presented in graphs. The second objective was supposed to analyze the alteration made by Balinese students and how the alteration might occur in the perspective of generative phonology. Furthermore, in this section, a new finding was assumed concerning how the dual system theory worked in these cases. The third objective explored how the study revealed the new model to describe how the bilingual learners interpreted the L2 language sound and implemented it into any type of realization. From these objectives, the implicit and explicit types of sound bilingual learning were applied and described for changing the student's problems and obtaining more accurate and better English alteration.

Data analysis

Data were classified and categorized based on the three objectives of the study to demonstrate the existing phenomenon. The first data classification was analyzed to find out the types of phonological errors and factors that cause the errors produced. All the types of errors and the percentage of alterations and distortion factors were calculated to see the percentage by dividing the total number of errors by the total number of errors timed 100. The acoustic features of the sounds were analyzed then phonemically and phonetically transcribed. Furthermore, with this spectrogram of all recorded sounds, the distortion of the consonants or vowels could be recognized from formants, pitch, duration, and intonation. The findings then were analyzed by dual coding theory to see how the sound language system worked and from the synthesis, a phonological coding system model could be formulated as a new finding of the study. This model was used to guide how implicit and explicit learning can justify the three different stages of the model.

Finding and Discussion

The data analysis was begun with the comparison of Balinese students' English pronunciation to the native English pronunciation. The comparison of pronunciation can describe phonological phenomenon from the sound structure and system of both different languages. The study analyzed and described the reconstruction of the mental concept of consonants and vowels, the phonological process, the domination of L1 and L2, and factors that caused the distortion and alteration in phonetic points of view. The finding of the study revealed

that substitution errors mainly occurred due to the difficulty of implementing the verbal stimuli into phonetic realization. The percentage of students' English phonological errors can be presented in Figure 1.
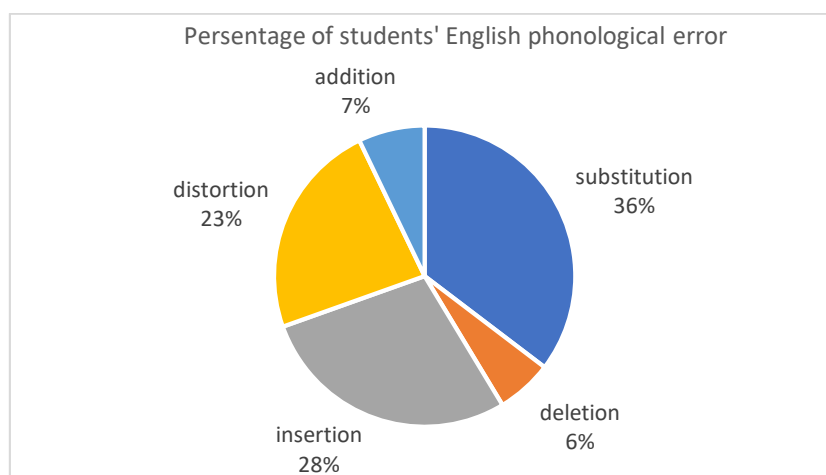
Figure 1. Percentage of English phonological errors by Balinese students

The students made 228 correct articulations or 30% from 760 students' total answers. The study revealed that the total number of incorrect articulations of English by 76 Balinese students was 532 or 70% of all data that consisted of 132 or 25% incorrect articulation of fricative consonants, 387 or 73 % incorrect allophones of the voiceless plosive consonant in the initial position, and only 11 or 2% incorrect vowel sound. All incorrect answers were classified into five types of incorrect pronunciation, such as substitution, insertion, addition, deletion, and distortion. There were 188 or 35% substitution, 32 or 6 % deletion, 150 or 28% insertion, 124 or 23% distortion, and 38 or 7% addition. Four factors that affect the errors consist of 128 or 18% overgeneralization, 133 or 25% incorrect rules, 138 or 26% false concepts, and 133 or 25% fossilized distortion.
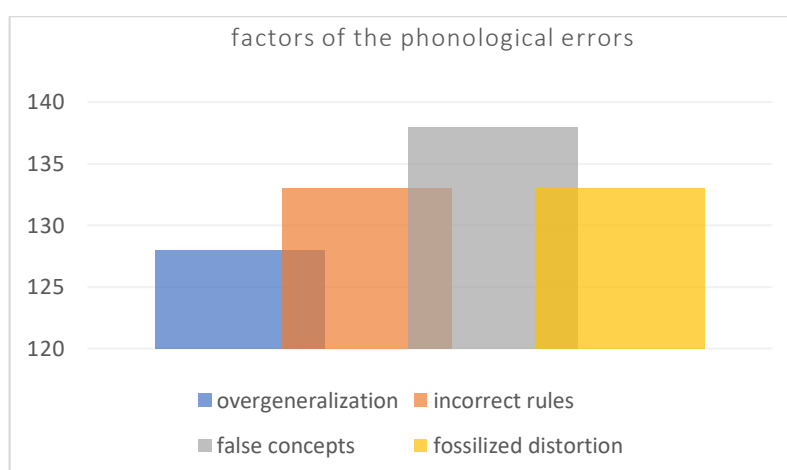
Figure 2. Factors of English phonological errors by Balinese students

Diphthong in Balinese can be found in initial and middle position of the words, but only few in final position, /iə/ like /tabiə/ 'pepper', /ai/ as in /sai/ 'often', /au/ as in /sau/ 'fishing net' and [uə] as in /muə/ 'face'. Balinese has mostly monophthong in the final position. This system

might interfere with the phonemic coding and phonetic implementation for the target sounds. However, the syllabic system of English as the target language allows diphthong in the final position. The novel articulation direction in English diphthong may arise from low to high or from high to low vowel, but in Balinese, the direction goes mostly from high to low position. Some Balinese diphthongs that do not match with English diphthongs in final position are /ei/, /əʊ/, /oʊ/, /oi/. So, the Balinese students mostly delete the last vowel to monophthong. So, it becomes /e/, /ə/, and /o/. a monophthong. Some examples of diphthongs that are pronounced as a single vowel are presented below.

today /təˈdeɪ/ → [tude]
okay /ˌəʊˈkeɪ/ → [oke]

Insertion

Consonant cluster in English phonological rules may consists of (1) [+obstruent] and [+obstruent], such as voiceless fricative + voiceless plosive, like /sp/ in speak, /st/in steal, /sk/in sky; (2) [+obstruent] and [+sonoran], like /fl/, /fr/, /sl/, /sr/, /sn/, /sm/, /pr/, /tr/, kr/, /pl/, and /kl/. In Balinese, some consonant clusters of /sp/, /st/, dan /sk/ in initial position or /lp/ in middle position can not be normal so the insertion of /ə/ occurs to simplify the complexity of the articulation. The insertion of /ə/may occur in the initial, medial, and final position. The mechanism of vowel insertion consonant clusters by Balinese students can be presented in Table 1.

Table 1. The mechanism of vowel insertion consonant clusters

| Position	Target sound	→	coding activation	→	realization
	A consonant cluster of L2		The sound system of L1		The sound system of L1
	/sp/	→	Φ → [ə] /CC		[səp]
Initial	speak /spi:k/	→	/spi:k/ → [səpik]	→	[səpik]
Middle	inspire /ɪnˈspaɪə(r)/	→	/ɪnˈspaɪə(r)/ → [ɪnˈsəpaɪə]	→	[ɪnˈsəpaɪə]
Final	wasp /wɒsp/	→	/wɒsp/ →[wɒsəp]	→	[wɒsəp]

The insertion of /ə/ between English obstruent consonant clusters by Balinese students phonetically occurs because the articulators take a longer time to anticipate the coming consonant articulation and the tongue is in the middle and central position [-front, - high, - back]. The Balinese students tend to simplify the complexity of two consonants by inserting the vowel /ə/. The absence of the sound system in L1 for articulating the sound of L2 influences the phonetic realization. In dual coding theory, different sound canal system ends at the junction so the sound simplification is implemented because at the moment the students are articulating /s/, the tongue anticipates the coming articulation of /p/ but it is too long and the insertion of /ə/ occurs. The spectrogram of the word 'speak' where there is not any insertion of middle and central vowel /ə/ in a consonant cluster of /sp/ can be presented in the following figure 3.
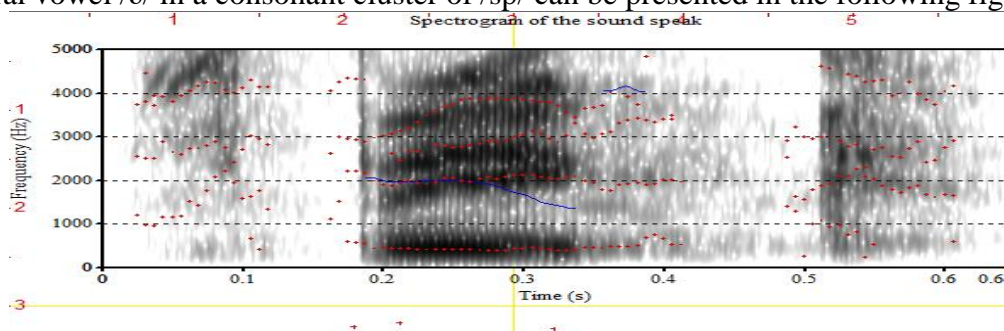

Figure 3. Spectrogram of the word 'speak'

Aspirated vs non-aspirated

English sound system has a phonetic variation called allophone. One of them is aspirated voiceless plosive consonants. Each voiceless plosive consonant, such as /p/, /t/, /k/ in initial distribution of words becomes aspirated [+aspirated]. Aspirated sounds are the sounds produced with a restriction between the release of closure of stop consonants, like [h] in [pʰ, tʰ, kʰ]. Phonetically, the software of Praat (Boersma, 2021), the delay of periodic time of voicing or voice onset time (VOT) occurs between the moment of the release and plosion. The aspirated voiceless plosive consonants have a longer VOT (Johnson, 2011). It is between 30-40 ms. It means that the longer duration occurs when the closure is released, the voicing begins with the vibrating vocal cord (see Boucher, 2002; Whitfield et al., 2018). The aspirated voiceless plosive consonants in the sentence "Can you take the cap for me please" is presented in the spectrogram below.
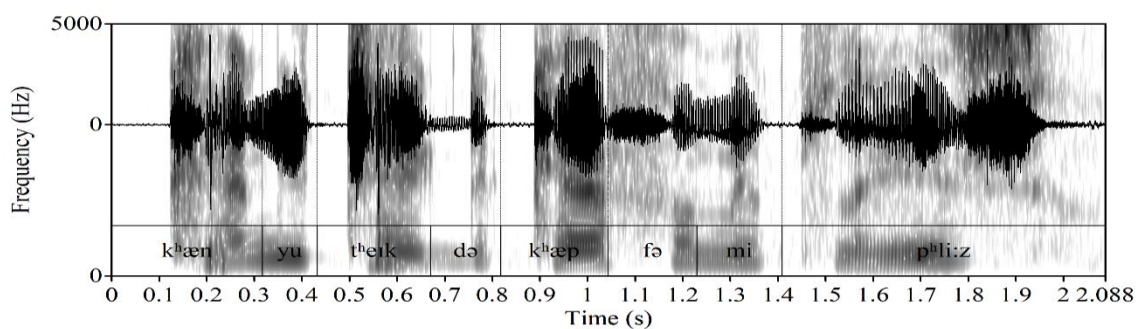
Figure 4. Spectrogram of aspirated voiceless plosive consonants

The sentence in the spectrogram that is uttered by an English native speaker requires only 2 seconds and 1 mile second, however, the Balinese students mainly take 2 seconds and 40 miles second. The Balinese sound system does not recognize aspirated voiceless plosive consonants in initial position or allophone, so the students articulate the aspirated sounds [pʰ, tʰ, kʰ] as the orthography or letters they read or use sound concepts they have in their language. From the perspective of dual coding theory, this phonetic case belongs to the referential category; activating the sound system of L2 by the system of L1 (Clark & Paivio, 1991).
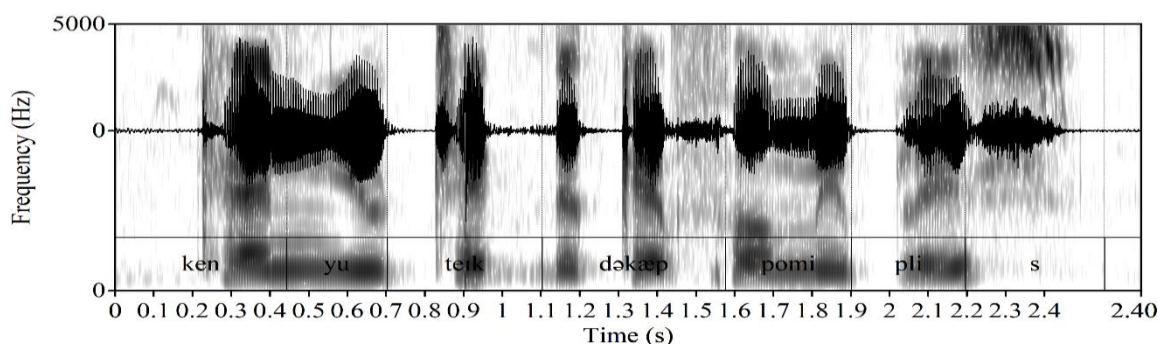
Figure 5. Spectrogram of unaspirated voiceless plosive consonants

Discussion

The types of phonological alteration

The phonological alteration by Balinese students in coding English speech sound occurs not due to the purely phonetic level but phonemic processing level. Though in fact, the

phonological process can be described as a phonetic phenomenon. Phonetically, many consonants of English were not accurately articulated by Balinese students due to the absence of those consonants in their orthography system. Phonemically, the English segments were altered for articulatory simplification. The types of phonological alteration found in the study include segment substitution, vowel insertion in consonant clusters, vowel and consonant deletion, and consonant addition. The segment substitution is concerned with the replacement of one segment with another segment, like diphthong is substituted by monophthong and the voiced alveolar fricative sound is substituted by voiceless sounds. Some features of phonological alteration between L1 and L2 in this study revealed that:

(1) the consonant addition in L2 results in deletion in L1;
(2) deletion in L2 can be an insertion in L1;
(3) voicing in L2 can be devoicing in L1;
(4) [+aspirated] in L2 can be [-aspirated in L1;
(5) diphthong in L2 can be monophthong in L1.

Phonological coding model

The dual coding theory emphasizes verbal and nonverbal language activation. However, these coding concepts in this theory also support sound phenomena in bilingual learning. This study proved that the two different languages, Balinese as L1 and English as L2, where the Balinese English learners activate the two-coding sound system in three ways. The first tendency is that direct activation of L1 for L2 that occurs either through a strong orthography stimulation of L2 or the absence of orthography of L1 results in L1 phonetic realization. The second tendency is that the two coding systems that are activated simultaneously due to language learning experience, phonological awareness, and language practice (Flege & Bohn, 2021) results in mixed L1 and L2 phonetic realization. The third tendency reveals that the stimuli of the L2 sound system are activated due to phonological awareness and results in L2 phonetic realization. In dual coding theory, Paivio (1990) states that the inputs of the sensory system connect L1 and L2 systems in representational, referential, and associative processing ways.

Based on the analysis of dual coding theory for the system of two different languages, this study established the sound system mechanism called the phonological coding model. The students activate the system of L2 independently but arrive at the phonetic realization of L1. For example, the Balinese students read the English word sit /sɪt/ and activate the L1 and pronounce it as [sit]. However, in L2, the tense vowel becomes a lax vowel if it is within consonants while the L1 does not. Mental sound processing occurs from coding, retrieval, and phonetic implementation. Some evidence revealed that Balinese speaking students in articulating English sounds activate both L1 and L2. However, the phonetic implementation can be purely L1, just purely L2, or mixed L1 and L2. This study suggests that the four levels of students' English articulation involve transmission, perception, phonological process, and phonetic realization. The activation of the sound system of L1 and L2 occurs in the perception level. The perception involves absorption and retrieval of the information and knowledge of both languages.

Explicit phonological learning

Concerning the model established in this study, the L2 phonological learning strategy may depend on the students' L2 phonetic realization level. The representational stage in the bilingual phonology coding model shows that students' English pronunciation is purely affected by the Balinese language. Therefore, the students may adopt elementary explicit learning by

acknowledging the phonological awareness of the English speech sound system. At the associative processing stage, Balinese and English systems have affected the students' English pronunciation simultaneously and resulted in inconsistent pronunciation; accurate on some occasions but inaccurate on another occasion. So, an intermediate explicit learning strategy might be worth applying by drilling or rehabilitating some aspects of phonological misconception with articulation practices. Finally, students whose phonetic realization are in the referential stage. requires the advanced explicit learning strategy to strengthen habit formation.

Conclusions

The sound coding system in bilingual learning in the present study refers to the phonetic realization of L2 into L1 and L1 into L2. The system of both languages may take control over the other through activating both language systems. The study reveals that the most dominant coding category is a referential coding system. Students activate the sound systems of L1 and L2 simultaneously. The activation results in incorrect English pronunciation or Balinese pronunciation of English. However, in conversation, the outcomes are still understandable. In this category, the sound of L2 was not in the same sound of L2, like voiceless and voiced fricative labiodental consonant /f/ and /v/ is articulated as voiceless and voiced plosive bilabial consonant /p/ and /b/. The referential coding category included the unaspirated voiceless plosive stop consonants in the initial position by L1 speakers. The influence of L1 resulted in the inaccuracy of L2. Therefore, there was the alteration of diphthong into monophthong. The direction of the low vowel to high vowel does not exist in L1. This study revealed that the dual coding theory in bilingual learning allowed the activation of L2 but realized the L1 outcomes. This study suggests the students and teachers apply explicit learning to form of communication habit in English by activating L2 to realize L2 in daily life speech interaction. This study recommends future research of bilingual learning for different linguistic branches, other language skills.

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