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Identification and Analysis Of The Existence of Word Stress Variation Between The Pronunciation Of Certain English Words Of Native English Speakers and Native Telugu Speakers

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ABSTRACT

Since the decline of the COVID-19 pandemic, immigration as a whole has been on the rise especially to the United States. The newly released census report for the years 2021-22 has reported an increase of over 1 million legal immigrants to the U.S. substantially comprised of Telugu speaking individuals. This research uses 8 native Telugu speaking adults and 8 native English-speaking adults to identify, analyze, and understand the existence of word stress variation between the pronunciation of the English language between the two groups. The results indicate that there indeed exists a significant difference in the position of word stress in the Telugu speakers' pronunciations with word stress predominantly applied to the last or second-to-last/penultimate syllable. The main cause for this shift in position was due to L1 interference from the mother tongue. These results have a plethora of implications for future research on sentences with and without punctuation marks, other major English stress rules, and different parts of speech that are commonly used in everyday language.

Introduction

There are approximately 7,168 living languages which refers to the languages "still being used and spoken by people" worldwide (Ethnologue, 2023). Language is "the principal method of human communication, consisting of words used in a structured and conventional way and conveyed by speech, writing, or gestures" (Oxford Dictionary, 2023). Furthermore, it is believed that language is an essential component of human connection as all species in the world use some form of communication whether it be through the use of body language, sound, smell, touch, or even chemical and electrical communication. However, for humans, language, in addition to being the heart of human interaction exists in every aspect of our lives; from improving communication between people to aiding in literacy efforts and even treating speech disorders (Canada Institute of Linguistics, 2023). Despite its benefits to the human species, language also poses difficulties prominently faced by immigrants, especially in the United States. According to a study by Pew Research Center, it was found that the immigrant population in the U.S. is on the rise with an estimated 78 million foreign born population by the year 2065 (Pew Research Center, 2015). However, this estimate may be lower presently due to the significant decrease in immigration during the COVID-19 pandemic. However, one important thing to note among the rising immigrant population is that a substantial percentage of immigrant adults and students are emigrants from India (Pew Research Center, 2015).

Furthermore, a report by the center for immigration studies indicated that the number of Telugu speakers in the United States grew 86% between 2010 and 2017 making Telugu one of the fastest growing languages in the U.S. Telugu is a language spoken predominantly in the Indian states of Telangana and Andhra Pradesh and is the 4th most widely spoken language in India (Mirchi9, 2022; Hanna & Batalova, 2021). This rapid growth was due to the links

between the Hyderabad and US engineering and technology industries which can be largely attributed to the rapid growth of information technology in the mid 1990's that led to a huge demand for software engineers and many were recruited from Hyderabad (Mirchi9, 2022). Furthermore, an estimated 70% of H1B visas which provides work visas to foreigners goes to Indian workers allowing them to apply for permanent residency (Mirchi9, 2022). Although it was found that Indians had a Limited English Proficiency (LEP) of 22% which is one of the lowest, compared to the other countries, it was found that Telugu speakers' communication was heavily hindered by their word stress as it was different from that of English that resulted in discrimination but also their professional growth would also be prevented due to strong accents (Hanna & Batalova, 2021). A study by Shadowen (2019) further found that proficiency in the English language was correlated with lower levels of depressive symptoms (Oxford University Press, 2019). The following study seeks to identify the location of word stress during the pronunciation of English words by native Telugu speakers to determine if there exists any variation in word stress and if so, why it is occurring.

Literature Review

Syllable and Stress-Timed Languages

Amongst the countless disciplines of Linguistics, Phonetics is one of the most significant subfields as it plays a crucial role in teaching and improving communication (Delahunty & Garvey, 2010). By definition, Phonetics is the "science or study of speech sounds and is concerned with all aspects of the production, transmission, and perception of the sounds of language" (Ashby, 2022; University of Buffalo, 2023). One of the most familiar distinctions of phonetics is between stress-timed and syllable-timed languages. This idea that languages had different rhythms was initially proposed and developed by Lloyd James (1940) when he observed that the rhythm of Spanish was evocative of that of a machine gun, whereas the rhythm of English recalled that of Morse code (Nespor et al., 2010; Conlen, 2016; Taghva & Abolhasani Zadeh, 2016; Mehler & Nespor, 2004; Ramus et al., 2000; Brown et al., 2017; Morales, 2020; Storto & Demolin, 2007; White & Mattys, 2007). Later, Pike (1945) termed these two types of rhythm 'syllable timed' and 'stress timed' respectively, a categorization often referred to as the "rhythm class hypothesis" (Nespor et al., 2010; Taghva & Abolhasani Zadeh, 2016; Mehler & Nespor, 2004; Brown et al., 2017; Ramus et al., 2000; Lee, 2020; Dickerson, 2015; Dauer, 1983; Roach, 1982; Morales, 2020; Storto & Demolin, 2007; Bertrán, 1999; White & Mattys, 2007). However, despite the various textbooks, research, and literature that had referred to the distinction between the different rhythm classes, nowhere was it made as explicitly as by Abercrombie (as cited in Roach, 1982, p. 1) who wrote "As far as is known, every language in the world is spoken with one kind of rhythm or with the other… French, Telugu and Yoruba… are syllable-timed languages,… English, Russian and Arabic… are stress-timed languages" (Lee, 2020). Moreover, Abercrombie (1967) and Pike (1946) later presented the theory of Isochrony better known as the "Isochrony Hypothesis" where they divided all languages of the world into those in which the "morphological stresses occurred at nearly equal intervals" known as stress-timed languages and those in which the syllables recurred at regular intervals as in syllable-timed languages (Nespor et al., 2010; Taghva & Vahideh, 2016; Ramus et al., 2000; Roach, 1982; Mok, 2009; Dauer, 1983; Brown et al., 2017; Dickerson, 2015; Morales, 2020; Storto & Demolin, 2007; Bertrán, 1999; White & Mattys, 2007).

Nevertheless, later phonetic research, which sought to identify the phonetic parameters and the physical properties of a language in order to characterize them into their appropriate rhythmic classes, failed to find isochrony in both syllables and interstress intervals (Roach, 1982; Nespor et al., 2010; Taghva & Abolhasani Zadeh, 2016; Mehler & Nespor, 2004; Ramus et al., 2000; Brown et al., 2017; Morales, 2020; Storto & Demolin, 2007; Mehler & Nespor, 2004). The research instead negated the existence of the different types of isochronous intervals in any spoken language giving rise to two proposals: one by Dasher and Bolinger (1982) suggesting that rhythmic classes didn't result from variation in rhythm between different languages, but were rather a "byproduct of either the coexistence or absence of different phonological phenomena within a language" (Mehler & Nespor, 2004; Ramus et al., 2000;

Morales, 2020; Taghva & Abolhasani Zadeh, 2016; Nespor et al., 2010; Ryu, 2002; Dickerson, 2015; Dauer, 1983; Bertrán, 1999; White & Mattys, 2007). And the other by Lehiste, which suggested that "the rhythmic classes are due to a perceptual illusion" (Mehler & Nespor, 2004; Ramus et al., 2000; Brown et al., 2017; Dickerson, 2015; Dauer, 1983). The first proposal found that stress-timed languages tended to have certain phonological characteristics that syllable-timed languages lacked. Nonetheless, these factors were all independent of each other which made it possible for languages to not be classifiable as either syllable or stress-timed, but instead would fall in between the two categories (Mehler & Nespor, 2004; Ramus et al., 2000; Morales, 2020; Taghva & Abolhasani Zadeh, 2016; Nespor et al., 2010; Ryu, 2002; Dickerson, 2015; Dauer, 1983; Bertrán, 1999; White & Mattys, 2007). As a result, it was proposed that languages existed along a continuum with the extremes being stress-timed languages and syllable-timed languages, therefore, rejecting the notion of rhythmic classes (Mehler & Nespor, 2004; Ramus et al., 2000; Morales, 2020; Taghva & Abolhasani Zadeh, 2016; Nespor et al., 2010; Ryu, 2002; Dickerson, 2015; Dauer, 1983; Bertrán, 1999; White & Mattys, 2007). The other proposal initiated many language discrimination studies "with infants, adults, and more recently non-human animals" (Mehler & Nespor, 2004; Ramus et al., 2000; Brown et al., 2017; Dickerson, 2015; Dauer, 1983). The linguists found that young infants, including newborns, could discriminate between sentences drawn from their mother tongue and a language from another rhythmic class (Mehler & Nespor, 2004; Ramus et al., 2000; Brown et al., 2017; Dickerson, 2015; Dauer, 1983).

Despite their results, these studies only suggested a subjective perception of isochrony and rhythmic classes (Mehler & Nespor, 2004; Ramus et al., 2000). It was not until the early 2000's that linguists began attempting to research ways to qualitatively categorize and quantify speech rhythms across all languages (Nespor et al., 2010; Taghva & Abolhasani Zadeh, 2016; Brown et al., 2017; Morales, 2020; Torgerson & Szakay, 2011; White & Mattys, 2007; Schultz, 2019; Ordin & Polyanskaya, 2015). Low et al. initially proposed the Pairwise Variability Index (PVI), which is "a measure of the average relative difference between successive pairs of units such as vowels and consonants in adjacent syllables" (Nespor et al., 2010; Taghva & Abolhasani Zadeh, 2016; Brown et al., 2017; Morales, 2020; Torgerson & Szakay, 2011; White & Mattys, 2007; Schultz, 2019; Ordin & Polyanskaya, 2015). Since its proposition, this method has become widely used in numerous studies to not only "address questions about rhythmic differences between or within languages" but has led to the examination of effects in L1 and L2 language studies (White & Mattys, 2007; Ordin & Polyanskaya, 2015; Torgersen & Szakay, 2011; Morales, 2020).

The History Of The Approaches and Effects of L1 Language/Mother Tongue on the Acquisition of the word/lexical stress of an L2 Language

Although L1 (first language or mother tongue) and L2 (second language) languages have been a topic of study since the 1940's and 1950's, the effect an L1 language has on an individual's acquisition of word stress of an L2 language has been largely understudied by linguists relative to the amount of research conducted regarding the acquisition of syntax and morphology especially in the English language (Liu, 2017; Guo et al., 2014). It has been proven by a myriad of these researchers that the L1 language has an incredibly noteworthy influence on an L2 languages' word stress. However, the relationship between any L1 and L2 is so complicated and abstract, that in order to study the influence, linguists have developed a variety of theories/approaches (Wang, 2014). There are two major theoretical approaches that linguists have been using to understand this complex relationship that initially sprouted from the idea of "transfer" which was first proposed by William Dwight Whitney to describe the influence of cross language (Wang, 2014; Khalifa, 2018; Tajareh, 2015; Thao, 2020; Alonso, 2017; Guo et al., 2014). However, it was not until Fries (1945) and Lado (1957) when the word "transfer" or "interference" was introduced to the study of Second Language Acquisition (SLA) (Wang, 2014; Khansir, 2012; Alonso, 2016; Thao, 2020; Khalifa, 2018; Aljumah, 2020; Guo et al., 2014; Ara, 2021).

Contrastive Analysis Hypothesis

The first major theoretical approach was the Contrastive Analysis Hypothesis (CAH) which was proposed by Lado (1957) (Wang, 2014; Alonso, 2017; Tajerah, 2015; Khalifa, 2018; Aljumah, 2020; Ara, 2021). Primarily used in the 1950's, the CAH was utilized as an effective means to address second or foreign language teaching and acquisition (Djiguimkoudre, 2020; Tajerah, 2015; Thao, 2020; Khansir, 2012; Mahmood & Ali Murad, 2018). It sought out to collate pairs of languages and identify the features of the L2 that resembled or differed from those of the L1 in order to predict where potential learning difficulties would arise (Djiguimkoudre, 2020; Tajerah, 2015; Thao, 2020; Khansir; 2012; Mahmood & Ali Murad, 2018; Dost & Bohloulzadeh, 2017). It suggested that the greater the difference between the L1 and L2 language, the more the L1 language would interfere making it difficult to learn the L2, resulting in the emergence of negative transfer or interference; whereas if the L1 and L2 languages were similar, the learners would generally acquire the L2 language with ease causing a positive transfer to take place (Richards, 2022; Wang. P, 2008; Ara, 2021; Dost & Bohloulzadeh, 2017; Guo et al., 2014). And if there was no relation between the structures of the L1 and L2 language, then zero transfer would appear (Dost & Bohloulzadeh, 2017; Guo et al, 2014; Richards, 2022; Wang. P, 2008; Ara, 2021). Lado's methods were found to be most successful in the area of pronunciation but less successful in the description of grammar and lexis. From its initial proposal, CAH was widely influential due to its association with behaviorism and structuralism. However, this association along with its theoretical and practical flaws and "new realities on the ground" ultimately led to the CAH's downfall dramatically declining its influence after the 1970's (Thao, 2020; Tajareh, 2015; Nuri, 2013; Khalifa, 2018; Richards, 2022; Aljumah, 2020; Ara, 2021).

Error Analysis Hypothesis

As a reaction to the CAH, the second major theoretical approach known as the Error Analysis Hypothesis (EAH) emerged and was often used as an alternative to the CAH (Khansir, 2012; Alonso, 2017; Khalifa, 2017; Ara, 2021). Initially introduced by Corder et al. in the 1960's the EAH primarily aimed to "determine and analyze the mistakes…" made by the L2 learners and the frequency of these mistakes to see what systematic patterns developed providing a broader range of possible ways to explain those errors rather than solely attributing them to the native language as was done in the CAH (Khansir, 2012; Alonso, 2017; Thao, 2020; Demir & Yilmaz, 2020; Tajareh, 2015; Khalifa, 2018; Ara, 2021). However, this appearance was not solely due to the inadequacies found in the CAH, rather it was also a result of a shift from a behavioristic to a mentalist model because it was found to give "researchers and teachers a more adequate basis to explain the learner production data" (Thao, 2020; Nifli, 2021; Maicusi et al., 2000; Obi, 2019). Nonetheless, the EAH was also criticized by numerous linguists who said that it was "an imperfect research tool" and failed to "serve as a primary mode of SLA analysis" due to what Rod Ellis (2008) mentioned as "weaknesses in methodological procedures, theoretical problems, and limitations in scope" (Khansir, 2012; Thao, 2020).

Even though both the CAH and EAH theories had their fair share of flaws, these two theoretical approaches came to be used in the majority of studies who looked at the effects of L1 on word stress acquisition of an L2. In a study conducted by Shaanxi Normal University, "the production of word stress by Chinese college students" was analyzed to determine any interference of Chinese (L1) on their English (L2) pronunciation. Researchers noticed that participants had the highest error rate for two-syllable and three-syllable words as they transferred the stress from the second to the first syllable. However, they discovered it was not due to L1 interference but rather because of the students' "inadequate knowledge of syllabic structure" and "mispronunciation of vowels". Further analysis disclosed that when a word contained more than one syllable, students were confused on where to place the stress. Furthermore, the teacher would correct the student without properly explaining necessitating the student to "memorize the correct response by imitating and repeating" (Liu, 2017). Whereas in a study that investigated the effect of Thai on English word stress production, the majority of the words pronounced by participants had shifted stress onto the ultimate syllable. Researchers concluded these errors were mainly caused by the differences between the stress patterns of English (L2) and Thai (L1) revealing substantial evidence of L1 interference (Jaiprasong & Pongpaitoj, 2020). Yet,

there still remained an unsolved problem when identifying word stress as neither the CAH nor the EAH could be used to identify on which syllable the word stress was being applied to as these theories only provided an explanation to determine in which particular areas an L1 language's word stress would negatively impinge on that of the L2 languages' thus determining the reason for errors, but also to elucidate the appearance of errors that should have been prevented. This resulted in a notable change from utilizing theoretical approaches, to using acoustic phonetics in order to recognize the position of the word stress.

Differences Between The Word Stress of Telugu and English Word Stress Patterns

There are many differences between the Telugu and English languages ranging from the order of subject, object, and verb to especially the difference between the placement of syllabic/word stress. Telugu is a language most widely spoken in the Southern states of India. Over 75 million people in the world speak Telugu and it stands second to Hindi in India which is quite surprising as Hindi is the national language of India requiring the entire population of India to learn it (Murad, 2018). According to linguists, the Telugu language belongs to the Dravidian language family which is much different from the Indo-Aryan language in which Hind and Sanskrit belong to. According to Murad, Telugu and English are as far apart as two languages can be. Although the Telugu and English languages share many differences, linguists especially notice a massive difference in the languages two very different word stress patterns. The major difference in word stress between the Telugu and English languages is that in Telugu, word stress is usually placed on the last or second to last syllable whereas in English, it has variable stress where the position of the stress is unpredictable (Demir, 2019). This is due to the fact that English word stress depends on many different factors whether it be based on the prefix a word or sentence starts with, the suffix it ends with, the context the word or sentence is being used in, the punctuation mark that the word or sentence ends in, etc. (Demir, 2019) This contrasts with some other languages – like Polish or Finnish – that have fixed stress where the stress on virtually any multi-syllable word falls on a particular syllable. Furthermore, it has been found that the vowels in the Telugu language are twice as long as those in the English language which has been shown to also affect the syllabic stress as the longer the duration in a syllable, the likelier word stress will be placed on that syllable as duration is one of the most important factors in identifying word stress in a word.

This leads to the gap that my research aims to close as although there have been countless studies in the existing literature that have compared the placement of word stress between stress timed and syllable timed languages, there have still been many gaps that have been looked over. One of the most prominent studies by Wiltshire and Moon which compared the difference in stress placement between Telugu and English only compared it between nouns and verbs whereas in my study, this study is basing off its words using four of the major stress rules in English. Furthermore, this study is using an older population between the ages of 35 and 60 years old compared to that of the studies by Wiltshire and Moon as well as Liu et al. (2017) who are using participants between the ages of 21 and 24 years old. These huge areas that haven't been studied yet lead to the research question this study seeks to answer: Does there exist a variation in word/syllabic stress regarding the placement of the primary stress during the pronunciation of certain English words between native Telugu speaking adults and native English-speaking adults?

Methods

For this study, the research method used was a combination of a descriptive research method and a case study research method to determine whether there existed a variation in word stress variation between the English pronunciation of native Telugu speakers and native English speakers. This research method was used due to its universal usage by many linguists around the world such as Ridder (2017), Liu et al. (2017), and Mahmood et al. (2018). Furthermore, it was found in a majority of existing literature that descriptive research aims to describe an existing phenomena as accurately as possible through an empirical inquiry which mainly focused on the "what" is happening rather than

giving an in-depth explanation of "why" this phenomena is occurring. However, without a way to understand why a certain phenomenon is taking place, this study would not be valid and have no real-world implications. Hence, it was decided to use the case study research method as it was found from a study conducted by Crowe et al. (2011) that this method allowed an in-depth, multi-faceted exploration of complex issues in their real-life settings. Furthermore, since this study would be using a mixed method analysis, both Qualitative and Quantitative information was required for the purpose of getting a comprehensive understanding and analysis of the study's results.

Participants

Sixteen adults from a city in Washington ranging in age of 35 to 60 years participated in the study (8 native Telugu speakers and 8 native English speakers from an American public high school). The participants were recruited by advertising surveys through email and text in group chat to allow all adults an opportunity to participate in the study.

Stimuli

The stimuli used in the study consisted of a list of sixteen different words (Appendix B) based off of four of the major English word stress rules (Appendix A). These four stress rules were chosen due to their common occurrence in literature during the initial research on word stress. The sixteen different words ranged from two-syllable to five-syllable long words as it was found in other word stress studies such as Chen et al. (2017) that participants had found it especially challenging when placing word stress on English words with two or more syllables.

Survey

Two surveys (Appendix C & D) were sent out as one was for the native English speakers and the other was for the native Telugu speakers. These surveys consisted of a total of twenty questions (Appendix C) and forty-two questions (Appendix D) respectively that were aimed at collecting basic demographic information such as "How long have you been living in Washington State? Or "What was the first language you learned?." The surveys were not based off of any previous studies as no literature referenced for this study used surveys. Furthermore, these surveys were primarily made in order to collect participants but also to get background information to be used during the use of EAH to identify any emerging systematic error patterns.

Procedure

After receiving survey submissions, consent forms (Appendix H) were sent out to selected individuals in the native English-speaking group. This selection was based off of whether the participants had moved to Washington state from a non-Pacific Northwest state after the age of 13 years. These participants were eliminated due to previous research studies' findings which stated that one's accent would become permanent at the age of thirteen so even if they move to another state, their accent would no longer be affected. Hence, if a participant moved from a state on the east to the Pacific Northwest region after the age of the thirteen, they would not have a Pacific Northwest accent. On the other hand, all native Telugu speakers were sent consent forms (Appendix H). These forms were sent out two weeks prior to when interviews were conducted. These forms included all information regarding a brief explanation of the study and the rights of the participants. Once consent forms (Appendix H) were returned back, a combination of emails, phone calls, and a scheduling app called When2Meet were used to schedule interview times.

Prior to starting the interview, the participant was given a brief summary of the study and of the consent form (Appendix H) they signed to refresh them on their rights in the case they wanted to opt out and did not feel comfortable. After all recordings were completed, each sound file was split in to sixteen individual smaller sound files for each of

the sixteen words pronounced by the interview. The Audacity sound files were then converted into MP3 sound files as the software application PRAAT only would use MP3 files.

Then, for each participant, all sixteen MP3 sound files were opened through the main menu of PRAAT, and a spectrogram was created for each of the sound files. Once the spectrogram was formed, each syllable was identified by listening to the spectrogram multiple times. Then each syllable was highlighted and the numerical values for the four factors: duration, pitch/fundamental frequency(f0), intensity, and quality (formant one and formant 2) were retrieved and noted down into a data table (Figure 1). The same procedure was performed for each of the stimuli (Appendix B) for each participant creating a large data table (Appendix E, F, & Figure 2).

Word (Syllables)	Intensity (dB)	Duration (Seconds)	Pitch (Fundamental Frequency/F0)	Formant 1 (Hz)	Formant 2 (Hz)
Ob	60.94	0.088	189.6	602.764	1085.557
lig	56.91	0.238	200.1	337.234	2220.244
a	61.03	0.116	229.1	437.455	2469.916
to	58.67	0.122	250.1	489.802	1720.892
ry	58.88	0.317	314.4	327.494	1717.516

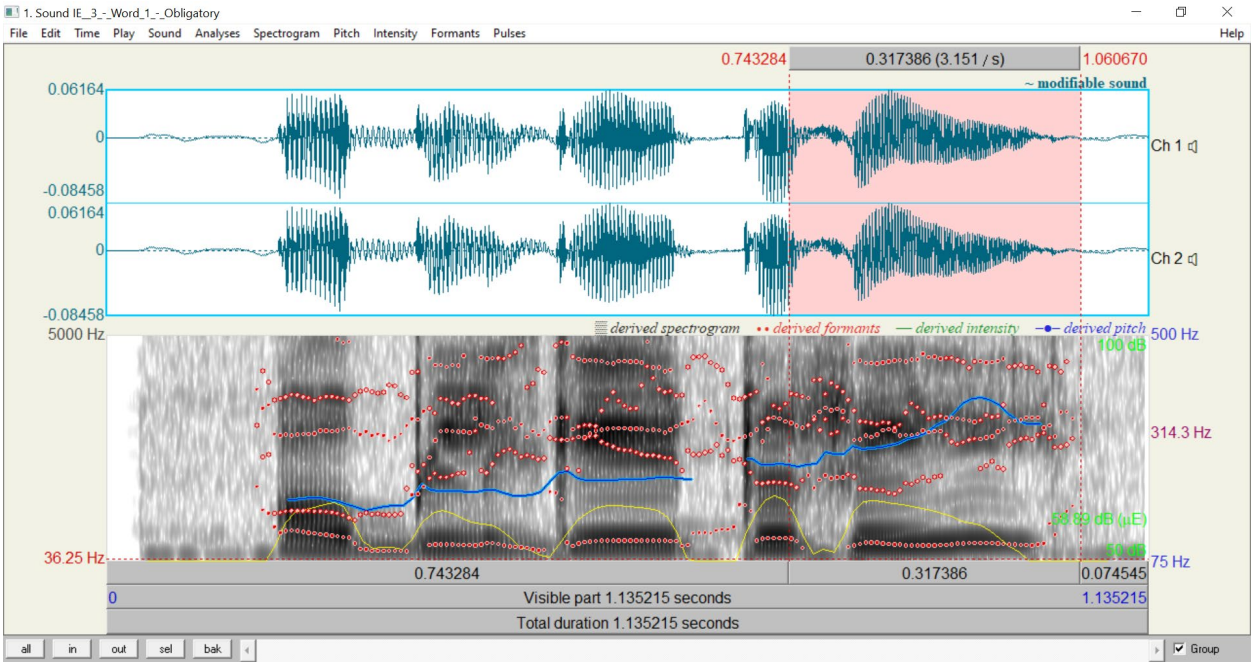

Figure 1. In the figure above, the software application PRAAT was used to produce spectrographs for the retrieval of numerical data for each of the four factors: duration, pitch/fundamental frequency/f0, intensity, and quality (formant one and formant 2) required to identify location of word stress to determine the existence of word stress variation. The spectrogram and data table shows the values retrieved from IE #3 sound files.

Word (Syllables)	Intensity (dB)	Duration (Seconds)	Pitch (Fundamental Frequency/F0)	Formant 1 (Hz)	Formant 2 (Hz)
Ob	60.94	0.088	189.6	602.764	1085.557
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to	58.67	0.122	250.1	489.802	1720.892
ry	58.88	0.317	314.4	327.494	1717.516
Pho	62.14	0.127	176.2	494.872	1022.052
to	61.71	0.155	187.7	510.318	1308.373
graph	58.45	0.32	224.1	616.071	2517.208
ic	56.04	0.375	318.7	421.986	2038.193
Run	59.84	0.273	170.3	590.537	1373.366
ner	58.76	0.452	288.5	381.485	1553.013
De	58.3	0.184	177.3	534.49	1887.469
moc	58.09	0.232	176.5	419.109	1121.122
ra	59.9	0.145	216.5	548.336	1732.556
cy	59.43	0.385	336.4	334.71	1584.95
Fan	59.85	0.233	175.9	525.248	2718.483
tas	57.19	0.311	91.13	831.932	1881.774
tic	57.46	0.383	342.6	428.689	2391.73
Butch	58.69	0.347	189.9	352.067	1304.007
er	59.48	0.377	340.9	513.479	1693.156
Pho	61.1	0.148	176.7	487.109	1150.483
tog	60.96	0.229	185	531.044	1305.179
ra	62.29	0.136	210.5	626.729	1628.713
phy	61.09	0.289	271.6	346.519	2013.377
Su	59.93	0.153	199.5	408.119	1201.8
per	61.21	0.179	199.9	590.935	1506.962
la	60.81	0.274	205.3	513.052	2144.538
tive	59.68	0.337	273	500.057	2212.407
Pho	58.91	0.134	172.2	490.938	1228.867
tog	57.04	0.206	175.3	522.469	1430.169
ra	59.7	0.155	172.3	642.676	1487.122
pher	57.17	0.273	219.1	617.179	1469.258
Ad	55.98	0.162	159.4	602.541	1977.982
mi	60.2	0.185	181.3	507.739	1814.55
ra	61.08	0.048	195.1	530.804	1682.056
ble	57.63	0.457	233.8	486.471	1702.735
Cut	61	0.172	161.2	642.363	1642.61
ter	59.17	0.257	262.8	570.67	1741.217
Nar	60.2	0.18	165.4	480.249	1874.459
ra	59.09	0.101	152.6	453.658	2021.426
tive	54.23	0.2715	135.5	481.061	1482.832
Car	63.94	0.245	192.4	764.162	1406.109
tog	64.04	0.168	213.2	450.232	1283.255
ra	63.76	0.21	200.4	567.881	1403.163
pher	61.37	0.233	208.3	526.8	1366.614
De	61.97	0.115	167.4	580.306	1364.957
vel	60.56	0.097	158	445.785	1420.546
op	57.02	0.169	160.5	550.239	1488.468
er	56.51	0.246	213.3	519.178	1464.858
Kill	59.32	0.174	185	371.96	2362.335
er	60.83	0.247	186.1	507.079	1607.344
Me	61.38	0.106	173.7	402.844	1918.585
tic	54.73	0.238	180.8	364.876	1963.419
u	62.03	0.084	205.6	361.765	1908.704
lous	58.68	0.347	212.1	504.088	1613.975

Figure 2. The above data table shows the data of IE # 3.

Each of the stimuli (Appendix B) were split into syllables and its numerical data received from the spectrogram on PRAAT was organized into a data table. Once all data tables (Appendix E & F) for each participant were created, the researcher went through each word and identified the syllable that contained stress. This was done by first comparing the value of the pitch and intensity factors between each of the syllables of the word. If it was identified that one syllable contained the highest values for pitch and duration, word stress was found to be placed on that syllable (Figure 3). However, if one syllable contained the highest pitch value but another syllable contained highest duration value, the values of the intensity and formants were compared between the two, deciding that the syllable with the highest values for the majority of factors contained the word stress (Figure 4). The syllable containing the word stress was then highlighted in green. This process was repeated for all sixteen words and for each participant (Appendix E, F & Figure 5).

Word (Syllables)	Intensity (dB)	Duration (Seconds)	Pitch (Fundamental Frequency/F0)	Fromant 1 (Hz)	Fromant 2 (Hz)
Ad	54.53	0.24	171.6	820.58	1272.339
mi	58.58	0.263	192.4	530.343	2167.497
ra	58.88	0.181	194.8	578.009	2007.985
ble	56.33	0.356	205.8	345.534	2069.297

Figure 3. In the above table from IE #7, it is seen that the values for duration and pitch factors are the highest (outlined in red) for the last syllable compared to all other syllables of the word. Therefore, it was determined that the word stress was placed on the last syllable (highlighted in green).

Word (Syllables)	Intensity (dB)	Duration (Seconds)	Pitch (Fundamental Frequency/F0)	Fromant 1 (Hz)	Fromant 2 (Hz)
Fan	50.51	0.363	127.3	644.237	1494.899
tas	49.061	0.32	136.6	636.795	1471.804
tic	49.627	0.25	195	357.324	1929.296

Figure 4. In the above table from IE #6, the first syllable has the highest duration value whereas the last syllable has the highest pitch value (outlined in red). So, the other factor values must be compared, and it is seen that the values for Formant 1 and Intensity is the highest for the first syllable compared to that of the second syllable (outlined in yellow). Therefore, the word stress is determined to be placed on the first syllable of the word.

Word (Syllables)	Intensity (dB)	Duration (Seconds)	Pitch (Fundamental Frequency/F0)	Formant 1 (Hz)	Formant 2 (Hz)
Ob	86.35	0.135855	148.1	763.904	1149.571
lig	84.8	0.242	154.1	361.431	1796.811
a	84.77	0.13067	139.1	439.046	2131.416
to	76.9	0.118	121	541.233	1523
ry	74.6	0.2022	115	316.928	2311.604
Pho	77.16	0.1472	140	513.249	1071.012
to	81.86	0.3016	165.3	538.909	1326.029
graph	79.38	0.325	138.5	724.527	1338.545
ic	74.67	0.1136	131.9	376.472	2184.96
Run	75.54	0.226	133	659.1048	1256.482
ner	78.43	0.228	144.174	714.832	1454.677
De	73.13	0.12	122.5	635.472	1649.626
moc	74.65	0.2415	149.5	583.907	1026.404
ra	79.53	0.0731	151.2	492.003	1547.434
cy	75.41	0.255	138.5	316.099	2324.206
Fan	72.38	0.245	133.5	629.864	1609.657
tas	80.42	0.273	171.3	740.813	1476.434
tic	74.86	0.1502	139.1	427.757	2089.306
Butch	74.454	0.307	132.192	393.04	1279.216
er	78.56	0.274	168.221	582.477	1787.592
Pho	69.72	0.106	132.7	483.366	1199.589
tog	76.13	0.25	145.4	558.326	1378.279
ra	80.76	0.133	144.6	708.96	1488.117
phy	70.92	0.273	137.5	304.296	2203.11
Su	77.29	0.217	158.4	480.161	1239.889
per	78.01	0.238	150.5	616.61	1216.144
la	74.91	0.249	135.6	496.315	1891.705
tive	68.949	0.175	123.718	374.262	1352.815
Pho	67.34	0.178	137.7	544.024	1134.444
tog	70.26	0.197	144.1	531.748	1482.277
ra	76.7	0.141	142	683.834	1443.382
pher	67.06	0.215	162.1	496.857	1218.663
Ad	70.73	0.201	134.5	664.9	1793.985
mi	74.49	0.157	156.1	622.358	1704.294
ra	77.376	0.0864	152.145	481.694	1536.021
ble	70.69	0.195	166.707	358.533	1299.385
Cut	71.56	0.179	125.4	683.126	1557.864
ter	71.77	0.199	137.8	611.607	1537.469
Nar	72.63	0.165	131.324	660.246	1663.034
ra	74.006	0.245	132.424	563.372	1918.298
tive	68.84	0.163	115.7	358.248	1221.754
Car	76.36	0.322	152.3	864.766	1249.695
tog	77.79	0.185	141.5	548.27	1385.045
ra	77.566	0.165	153.823	773.645	1447.301
pher	67.9	0.182	151	483.455	1204.967
De	76.13	0.083	142.4	685.095	1420.285
vel	75.25	0.087	142.2	658.053	1287.865
op	70.627	0.169	141.9	627.992	1360.849
er	71.97	0.148	196.781	545.876	1289.334
Kill	74.601	0.16	162.611	436.28	1465.953
er	75.233	0.228	165.8	663.908	1552.358
Me	69.919	0.195	140	509.395	1913.966
tic	58.84	0.218	172.3	350.964	2109.304
u	64.323	0.033	172.04	413.689	1449.861
lous	76.38	0.222	177.3	542.9	1582.888

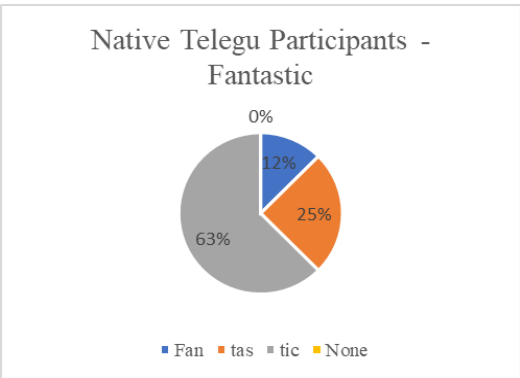
Figure 5. The above complete data table belongs to IE #1, and it can be seen that the syllable that contains the word stress is highlighted in green based on the comparison of the four factors' values.

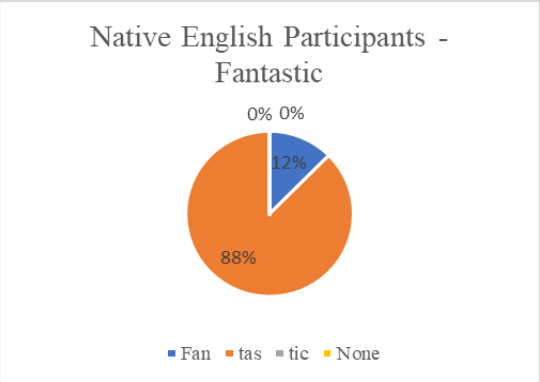
Results

The two surveys collected for the purpose of acquiring subjects for interviews were completed by a total of thirty-four participants. Eight having taken the native Telugu participant survey and twenty-six who took the survey for the native English speakers. Of the twenty-six responses for the native English-speaking survey, a total of fifteen responses were eliminated. Two responses were eliminated because they were test responses completed by myself and my teacher for the purpose of verifying whether all branching was done correctly and could be easily understood by participants.. Three responses were discarded as participants did not feel comfortable with providing their name in the survey. Furthermore, three more responses were eliminated as the participants were unable to complete and return the consent form (Appendix H) and/or were unable to schedule their interview at a time that worked for both researcher and participant. An additional two responses were also discarded because participants had made multiple submissions to the survey in order to turn in their results from the New York Times Dialect Quiz that they were unable to on their first submission due to the interference of a paywall.. Finally, as stated earlier in the procedure section, two responses were not used as those participants had moved to Washington State from a different state outside the states of the Pacific Northwest (Oregon, Washington, Idaho, Wyoming, and Alaska) after the age of thirteen years. On the other hand, all eight participants' from the native Telugu speaking participants were utilized in the study. After eliminating the above responses from the native English speakers survey, a total of 10 participants remained. However, I wanted to have an equal number of participants in each group, so I randomly chose eight participants through a spinner in order to prevent any potential bias from arising. In the end, sixteen participants were selected to be interviewed and their pronunciation was later analyzed. A combination of acoustic analysis through the utilization of the software application PRAAT to recognize the position of word stress and the application of the EAH to identify the emergence of any systematic error patterns not due to interference from the L1 language were used to come to conclusions about the existence of word stress variation between the English pronunciation of native Telugu speakers and native English speakers.

Each participants' syllabic stress placement on the same stimuli was organized and displayed onto a data table in order to better understand the results and be able to draw conclusions (Figures 6-7 & Appendix G). This creation of data tables (Appendix G) was repeated for the other stimuli including both native English speakers and native Telugu speakers.

Syllabic Stress Placement - Fantastic		
Syllables	Native Telegu Participants	Native English Participants
Fan	1	1
tas	2	7
tic	5	0
None	0	0





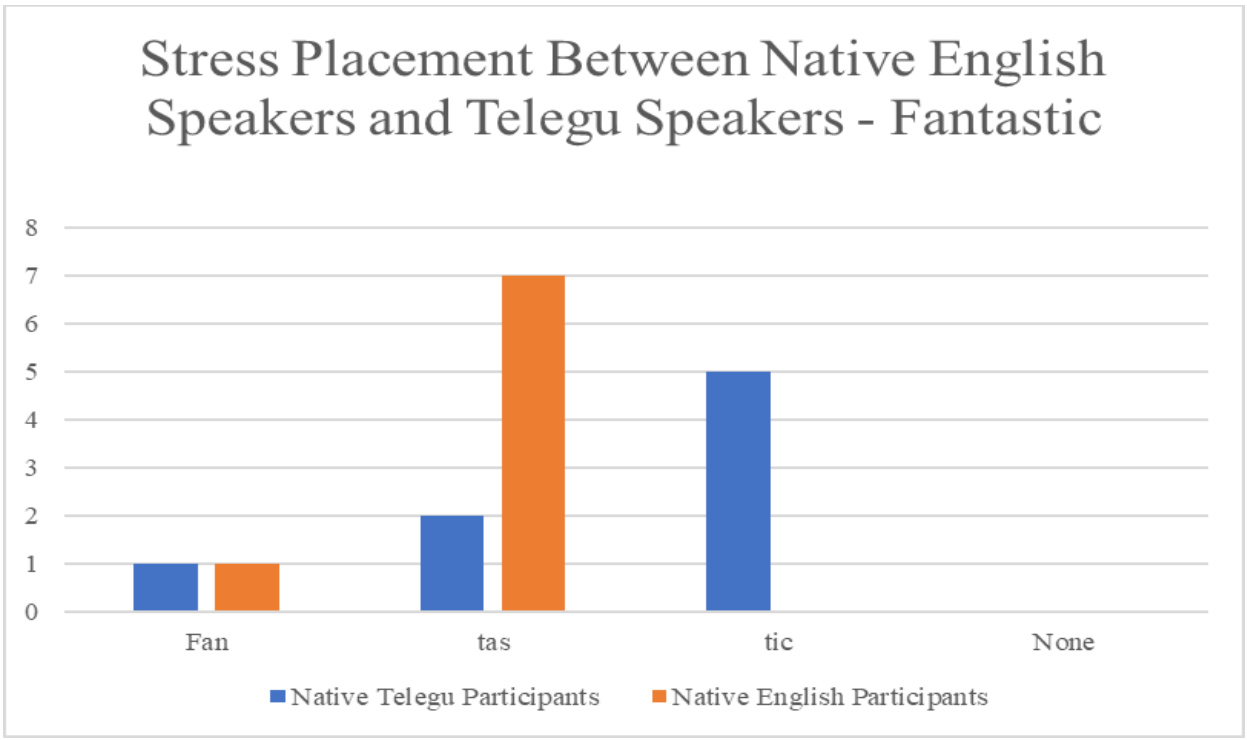
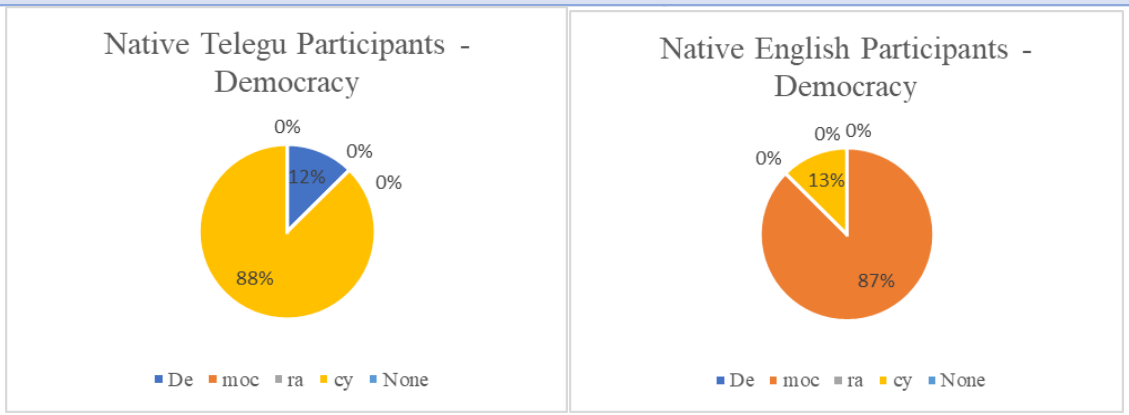


Figure 6. The above is a data table of the number of native Telugu speakers and the number of native English speakers who placed their syllabic/word stress on each syllable for words following the major English stress rule ending with -ic. This data table is also represented graphically through bar charts and pie charts to show the relative percentages of speakers on where they placed their syllabic stress.

Syllabic Stress Placement - Democracy		
Syllables	Native Telegu Participants	Native English Participants
De	1	0
moc	0	7
ra	0	0
cy	7	1
None	0	0



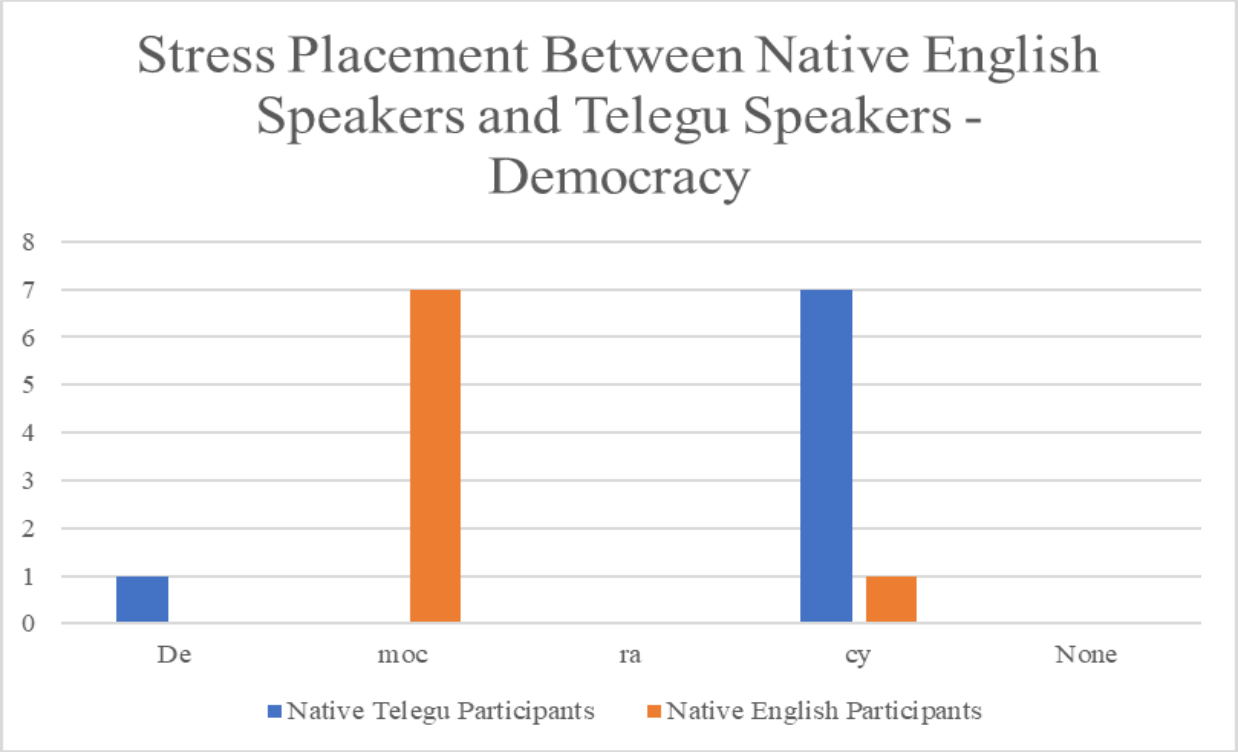


Figure 7. The above is a data table of the number of native Telugu speakers and the number of native English speakers who placed their syllabic/word stress on each syllable for words following the major English stress rule ending with -phy or -cy. This data table is also represented graphically through bar charts and pie charts to show the relative percentages of speakers on where they placed their syllabic stress.

Analysis

The quantitative data represented in the data tables and graphically represented through pie charts and bar charts (Appendix G) were later grouped/categorized under each of the major stress rules (Appendix A) that they belonged to. Once categorized, a new data table was formed in order to understand the overall results of the difference in word stress variation if any for each stress rule between the native English speakers and the native Telugu speakers (Figure 8). Along with this, the Error Analysis Hypothesis (EAH) was also used in order to qualitatively analyze the results to identify whether there were any errors not attributed to the interference from the L1 language that had led to this difference in word stress placement of the participants.

Words ending in -ic --> The second to last/ Penultimate Syllable					
Syllable	Native Telegu Participants	Native English Participan	Syllable	Native Telegu Participants	Native English Participan
First	1	1	First	0	0
Second	2	7	Second	1	0
Third	5	0	Third	4	8
None	0	0	Fourth	2	0
			None	1	0

Figure 8. The above data table is representative of all the words that apply to the major English stress rule regarding the words ending in -ic.

Words Ending in -phy, -cy - Third From the Last/Ante Penultimate Syllable		
Syllable	Native Telegu Speakers	Native English Speakers
First	4	0
Second	1	15
Third	0	0
Fourth	11	1
None	0	0

Figure 9. The above data table is representative of all the words that apply to the major English stress rule regarding the words ending in -cy or -phy.

Words Ending In -er --> First syllable For Two Syllable Words and Third to Last/Ante penultimate for Four Syllable words					
Syllable	Native Telegu Speakers	Native English Speakers	Syllable	Native English Speakers	Native Telegu Speakers2
First	4	2	First	5	22
Second	4	15	Second	18	2
Third	3	1	None	1	0
Fourth	12	0			
None	0	0			

Figure 10. The above data table is representative of all the words that apply to the major English stress rule regarding the words ending in -er.

For Three Syllable Word --> Word Stress Placed on the First Syllable & Four Syllable and Five Syllable If No Prefix Or Suffix Rule Applies --> Word Stress Placed on Second Syllable								
Syllable	Native Telegu Participant	Native English Participant	Syllable	Native Telegu Participan	Native English Particip	Syllable	Native Telegu Participan	Native English Participan
First	5	8	First	3	10	First	0	0
Second	1	0	Second	1	10	Second	3	5
Third	1	0	Third	5	2	Third	0	0
None	1	0	Fourth	15	2	Fourth	0	1
			None	0	0	Fifth	4	2
						None	1	0

Figure 11. The above data table is representative of all the words that apply to the major English stress rule regarding the words with four syllables and five syllables.

Discussion

From analyzing the results above, it can be seen that a majority of the Telugu participants have placed their syllabic stress on the second to last or last syllable of word no matter what English rule this word applied to. The comprehensive data tables (Figures 8-11) further support this conclusion as it can be seen that in Figure 8 which displays the data table for the English stress rule that for a three-syllable word, five of the Telugu participants placed their syllabic/word stress on the last syllable compared to seven of the native English speakers who applied their word stress to the penultimate syllable. We see that this trend continues for Figure 9 as well where there are eleven Telugu speakers who placed their syllabic stress in the last syllable compared to fifteen English speakers who placed their syllabic stress on the second syllable as stated by the major English rule. This occurs again for the third major English stress rule in Figure 10 with twelve Telugu speakers on the last syllable and fifteen English speakers on the second syllable.

Error Analysis

Since it was found that there indeed was a difference is word stress variation between the pronunciation of English words by native Telugu speakers and native English speakers, the EAH was used to identify why this word stress variation existed/took place. In order to apply this method to the results, the individual data tables, graphs, and pie charts (Figures 6-11 and Appendix G) were analyzed in further detail by looking at how many speakers placed word stress on each syllable between the two groups. After further analysis using the EAH, it was found that the majority of Telugu speakers were commonly shifting their stress to the last or second to last syllable because according to Demir (2019) and Murad (2018), as previously stated in the Literature Review, in the Telugu language, word stress is most commonly placed on the last or second to last syllable. As a result, it was found that the majority of the errors that the Telugu speakers made which in this case was word stress was caused by L1 interference. However, it was also noticed during the analysis of the charts and graphs (Appendix G) that a small percentage of the Telugu speakers had placed syllabic/word stress on the first syllable of a word which had no relation to the common characteristics of the Telugu language that could have possibly caused this change. But it was later found through the Telugu participants' demographics in the survey (Appendix D) that these speakers had written down that one of the first languages they had either learned or studied in their school was Hindi. After doing further research into the stress patterns of the Hindi language, it was found that in Hindi, word stress is placed on the first syllable of a word (Jones, 1971). So, we can see that the result/findings of this study directly answer the research question as there is in fact a significant variation in word stress between native Telugu speakers and native English speakers and it as found through acoustic analyses and Error Analysis that the cause of stress shift was due to L1 interference and the acquisition of Hindi during the early years.

Limitations

In this research study, there were many limitations. However, one main limitation that emerged was the occurrence of sampling bias especially among the Telugu speaking participants. All of the Telugu participants were pulled from a single community within Washington State as this was the only area in which the researcher had access to Telugu speakers. Furthermore, the majority of the Telugu participants were directly contacted to see whether they were interested in participating in the study as sending the survey through a large group chat was found to be largely unsuccessful. This further exacerbates the sampling bias because not only is the population from a single community, but now the majority of the participants have been handpicked from that single community. Therefore, the findings of this study would not be comprehensive/representative of the entire Telugu speaking population in Washington State let alone the United States. Another major limitation of this research I encountered is the fact that the Telugu speakers have been living in the state of Washington for an average of 18.8 years. This could mean that there is a possibility that the Telugu speakers have already been exposed to the words used in my study which could have further skewed my results as the participants would know how to pronounce these words in the correct way and not in the most natural way possible. Furthermore, the participants are from a variety of different cities and villages within the states of Andhra Pradesh which could lead to slight variation in how they pronounce certain words which could have affected their placement of word stress. Finally, I only based my stimuli (Appendix B) off of four of the major English stress rules (Appendix A) so although the Telugu speakers did shift their word stress placement, the results of this study cannot be applied to the entire English language as there may arise differences when tested with sentences, words with multisyllabic words, or even using different punctuation marks (exclamation marks, question marks, etc.) at the end of the sentence may lead to significantly different results.

Implications

There is a plethora of implications that the findings of this research study pose. Firstly, the information about the variation in word stress placement can be used in both English Foreign Language (EFL) teaching centers that many immigrants tend to take to improve their pronunciation of the English language but also in EFL classes in high schools for students who have recently immigrated and aren't very familiar with the English language. Additionally, by helping immigrants be able to achieve an accent and pronunciation similar to that of a "natural English speaker", the LEP of the Telugu participants could be further lowered but more importantly can reduce/prevent the development of depressive symptoms in individuals as previously mentioned by the results of Shadowen's research study. It is also important to understand that by identifying the problem in the word stress placement made by the native Telugu speakers, they are less likely to be discriminated against or bullied by their peers whether it be in the workplace environment or school environment. However, there is one major negative implication can arise from the results of this study being that the amount of discrimination and bullying faced by the Telugu speakers can possibly cause them to associate bad experiences with their mother tongue so once, they have successfully learned the correct English pronunciation, they tend to not use their mother tongue anymore which can result in the extinction of their language.

Future Research

Future researchers should study larger populations of both native Telugu speakers and native English speakers from a wider range of states or areas so that the results will be more representative of the entire Telugu speaking population in a certain area or state. Furthermore, this research study only used words as stimuli which only provided limited information about the difference in word stress variation. However, if expanded to sentences, the study will get results that are more precise and appliable to a larger population. Further delving into the demographics of the participant population will also allow the future researchers to be able to use the EAH at a more extensive and deeper level therefore giving more meaningful and detailed results.

Conclusion

In conclusion, it was found that indeed there is a significant variation in word stress between the pronunciation of certain English words between native Telugu speakers and native English speakers. This phenomenon can be supported with evidence of L1 interference because as mentioned earlier in the literature review, we see that the in the Telugu language, the majority of syllabic stress is placed on the second to last or last syllable of a word. However, it was also found that through the use of the Error Analysis Hypothesis, we saw that the participants' other languages also had a significant effect on the placement of their word stress as it was found that a small percentage of participants had been learning the Hindi language at the same time as they were learning the Telugu language. This caused participants to place their syllabic stress on the first syllable sometimes which is a common characteristic of the Hindi language. In the end, the results of this study have a closed a significant gap in existing literature that has a very large impact on the immigrant population. Yet there still are many smaller gaps that remain open for future researchers to work off of.

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