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Language in India www.languageinindia.com ISSN 1930-2940 Vol. 25:4 April 2025

# Cross-Linguistic Differences in Stress Perception: A Study on Kannada, Telugu, and Malayalam Speakers

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**Abstract**

Stress perception plays a crucial role in speech processing, influencing language acquisition and communication. The study aims to explore how the phonetic and prosodic characteristics of these Dravidian languages affect listeners' ability to perceive stress patterns in Kannada, their non-native language. A controlled experimental design was done, involving 15 Kannada-speaking participants as the control group and 30 Telugu- and Malayalam-speaking participants as the experimental groups. Using a series of stress-marked two-word Kannada phrases, the participants' ability to perceive stress based on suprasegmental cues such as vowel duration, fundamental frequency (Fo), and intensity was evaluated. The results revealed significant differences in stress

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perception abilities among the groups. Native Kannada speakers achieved near-perfect scores of 100%, while Telugu speakers obtained a mean score of 56.88%, and Malayalam speakers performed the worst with a mean score of 42.5%. The findings indicate that Kannada speakers rely heavily on vowel duration for stress detection, whereas Telugu and Malayalam speakers, with more complex stress systems, show less efficiency in perceiving stress in Kannada. These results highlight the influence of native phonological systems on second language stress perception and suggest implications for language teaching and speech therapy, emphasizing the need to consider cross-linguistic influences in second language acquisition.

**Keywords:** Cross-linguistic differences, multilingualism stress perception, speech perception, suprasegmental cues and second language.

## Introduction

Speech perception is the ability to interpret and understand spoken language by converting continuously changing acoustic signals into meaningful linguistic units [1]. It is a fundamental aspect of human communication, involving interactions between auditory processing, phonetics, phonology, and cognitive mechanisms. Effective speech perception is crucial for language acquisition, speech recognition, and verbal communication. Research in this area spans multiple disciplines, including psycholinguistics, neurophysiology, phonetics, and artificial intelligence. One key component of speech perception is phonological processing, which includes phonemic awareness, phonological recording in lexical access, and short-term verbal memory skills [2]. Language background significantly influences speech perception, particularly in stress pattern recognition and phonetic contrasts. Studies indicate that non-native speakers often struggle with perceiving and producing stress patterns due to differences in their native phonological systems [3-4]. Bilingual and multilingual individuals experience cross-linguistic influences, where the phonetic and prosodic characteristics of one language affect the perception and production of another. Stress perception varies across languages; for instance, English employs lexical stress, where stress placement changes word meaning (e.g., 'permit' as a noun vs. 'permit' as a verb), whereas languages like Bengali have fixed stress patterns and explored the role of acoustic cues

such as pitch, duration, and intensity in stress perception [5-6]. Telugu and Malayalam, two Dravidian languages, exhibit distinct phonetic and stress patterns. However, limited research has examined how native speakers of these languages perceive stress contrasts in a non-native language. Understanding these variations is essential for language learning, speech therapy, and auditory rehabilitation.

[7] Described Kannada stress as typically falling on the first syllable, while [8] characterized Telugu as a mora-timed system [9] further investigated Malayalam, demonstrating that stress placement depends on vowel length and syllable position. The Stress Deafness Model [10] suggests that speakers of fixed-stress languages struggle with stress contrasts in an L2. [11] Proposed the Stress Typology Model, which predicts varying difficulties based on L1 stress predictability. [12] Emphasized the influence of linguistic background and proficiency on stress perception. [13] Found that bilinguals show L1 influence on L2 stress perception, with more proficient bilinguals adapting better to L2 prosodic contrasts. [14] Revealed that Cantonese-English bilinguals outperformed native English speakers in lexical stress discrimination, suggesting an advantage from tone language experience. [15] Showed that phonetics training aids stress detection, particularly in bilinguals. [16] Demonstrated that adverse acoustic conditions increase listening effort, particularly for non-native listeners. [17] Examined bilinguals' ability to understand non-native speech, finding that they performed better than monolinguals but did not necessarily benefit from shared linguistic backgrounds. [18] Found that both native and non-native speakers adjust their speech for better intelligibility. [19] Concluded that Spanish speakers did not always transfer stress patterns to English. [20] Proposed the Native OPERA Hypothesis, suggesting that musicianship enhances stress discrimination. [21] Investigated word stress perception, highlighting that suprasegmental cues aid word recognition primarily in languages where they reduce lexical competition. [22] Explored foreign language anxiety, showing that younger and strict teachers increased student anxiety, whereas pedagogical skills enhanced enjoyment. [23] Emphasized the role of online learning in increasing language anxiety and proposed strategies to mitigate it. [24] Demonstrated that augmented reality with speech input enhances children's language learning. [25] Found that awareness of learning goals influenced

students' perceptions of teacher feedback. [26] Examined the relationship between multilingualism, well-being, and stress, concluding that higher subjective well-being and lower stress levels enhance language learning enjoyment. [27] Provided evidence that European Portuguese-learning infants as young as 5–6 months exhibit sensitivity to stress patterns, reinforcing the importance of early exposure to language-specific phonetic properties.

Kannada, a Dravidian language, primarily uses vowel duration as a key cue for stress perception, with stress typically falling on the first syllable. This means that the phonetic structure of Kannada encourages speakers to use vowel length as the primary cue for identifying stressed syllables. In contrast, Telugu, which follows a mora-timed system, relies on syllable length and vowel length for determining stress placement. This allows Telugu speakers to place stress on longer syllables or those containing long vowels. Malayalam, another Dravidian language, is more complex due to its multi-centric stress system, where stress can shift between syllables depending on factors such as syllable position and vowel length, resulting in both primary and secondary stress patterns.

Research on stress perception has demonstrated the influence of phonetic, phonological, and cognitive processes in recognizing speech sounds. While studies have examined various languages, there is a lack of research focusing on Telugu and Malayalam speakers' stress perception in an L2 context. This study aims to bridge that gap by analyzing how these speakers perceive and differentiate stress patterns, contributing to the broader understanding of bilingual speech perception.

**Method**

This study utilized a controlled experimental design to investigate the relationship between stress perception and duration cues in different native language groups. Participants were divided into control and experimental groups based on their linguistic backgrounds and audiological screening criteria.

**Participants**

The study included the following groups:

**Control Group:** Comprising 15 healthy, normal-hearing volunteers who were native Kannada speakers. All participants in this group passed a screening audiological evaluation.

**Experimental Group:** Divided into two subgroups:

**Group 1:** Normal-hearing adults with Telugu (15N) as their native language.

**Group 2:** Normal-hearing adults with Malayalam (15N) as their native language.

**Age Range:** The participants in both groups are aged between 25 and 35 years, with a mean age of 30 years (See table 1).

**Table 1:** Details of participants and audiological data across languages

| **Languages** | **No. of Participants** | **Mean Age (yrs)** | **Mean Pure Tone Average (dBHL)** | | **Speech Identification Scores (%)** | |
|---|---|---|---|---|---|---|
| | | | **RE** | **LE** | **RE** | **LE** |
| **Telugu** | 15 | 30 | 15 | 15 | 100 | 100 |
| **Malayalam** | 15 | 30 | 16 | 16 | 98 | 98 |
| **Kannada** | 15 | 30 | 16 | 16 | 99 | 99 |

**Inclusion Criteria**

- Participants across all groups were required to meet the following inclusion criteria:
- No history or complaints of middle ear infections, tympanic membrane perforations, head trauma, noise exposure, or ear discharge.
- Pure-tone air and bone conduction thresholds below 15 dBHL at octave frequencies between 250 Hz and 8000 Hz, measured using the Modified Hughson and Westlake procedure [28].

- Speech recognition thresholds within +12 dB relative to the pure-tone average.
- Speech identification scores greater than 90% in both ears when presented at 40 dB SL (reference: SRT).
- Type "A/As" tympanogram with 226 Hz probe tone, with both ipsilateral and contralateral reflexes present at conventional test frequencies.
- No reported illnesses on the day of testing.

**Procedure**

All audiological tests and experiments were conducted in a well-ventilated, air-conditioned, sound-treated room with noise levels conforming to ANSI S3.1 (1996) standards.

**Stimuli Preparation**

- Twenty-eight meaningful two-word phrases from prior research [29] were selected. These phrases were produced with stress placed alternately on the first or second word, emphasizing duration cues.
- Recordings were made by a professional adult female Kannada speaker, skilled in modulating supra-segmental features like stress. The phrases were recorded using a 12-bit A/D converter with a 16000 Hz sampling frequency.
- All recordings were normalized for consistent intensity and divided into two lists. A calibration tone of 1 kHz was generated using Adobe Audition software and played before the test stimuli.

**Audiological Testing**

1. Pure-tone thresholds and speech identification scores were measured using a calibrated dual-channel Maico MA 42 diagnostic audiometer with TDH-39 headphones and MX-41/AR ear cushions. Bone conduction thresholds were assessed with a Radio Ear B-71 bone vibrator.

2. Speech identification scores were measured in quiet using open-set word lists developed by [30-31] for Kannada, Telugu, and Malayalam listeners, respectively, at a presentation level of 40 dB SL002E
3. Immittance testing (tympanometry and acoustic reflexes) was performed with a calibrated Maico MI 34 middle ear analyser using a 226 Hz probe tone. Reflexes were tested ipsilaterally and contralaterally at 500 Hz, 1 kHz, 2 kHz, and 4 kHz.

**Testing Protocol**

Stimuli were played using Adobe Audition software via an i3 core duo computer routed to the tape/auxiliary input of the audiometer. Phrases were presented through TDH-39 headphones at 40 dB SL.

Participants identified the stressed word in each phrase, and responses were recorded. A score of one was given for each correct response, while incorrect responses received a score of zero.

**Data Analysis**

The percentage of correct responses was calculated for all participants and subjected to statistical analysis to evaluate differences between groups and conditions.

**Statistical Analysis**

Tests such as Levene's test of equity, ANOVA and post hoc were done by using SPSS 20 software to evaluate the means, standard deviations, standard error, and significant differences.

**Results**

The results revealed significant differences in stress perception abilities among native and non-native listeners. Participants in the control group (native Kannada speakers) achieved a perfect mean score of 100%, demonstrating their ability to effectively use supra-segmental cues such as vowel duration, fundamental frequency (Fo), and intensity to perceive stress. In contrast, native

Telugu listeners obtained a mean score of 56.88 %, while native Malayalam listeners performed the lowest, with a mean score of 42.5 %. Statistical analysis revealed that the Levene's test of equity was administered and observed that the error variance of the dependent variable is equal across the groups [F (2, 93) = 24.2, p<0.001]. (See Table 2 and Figure 1).

**Table 2:** Shows the mean, SD and SE of stress perception across languages

| Native Language | Mean | SD | SE of Mean |
|---|---|---|---|
| **Telugu** | 56.88 | 18.4 | 2.59 |
| **Malayalam** | 42.5 | 17.41 | 2.59 |
| **Kannada** | 100 | 0 | 2.59 |

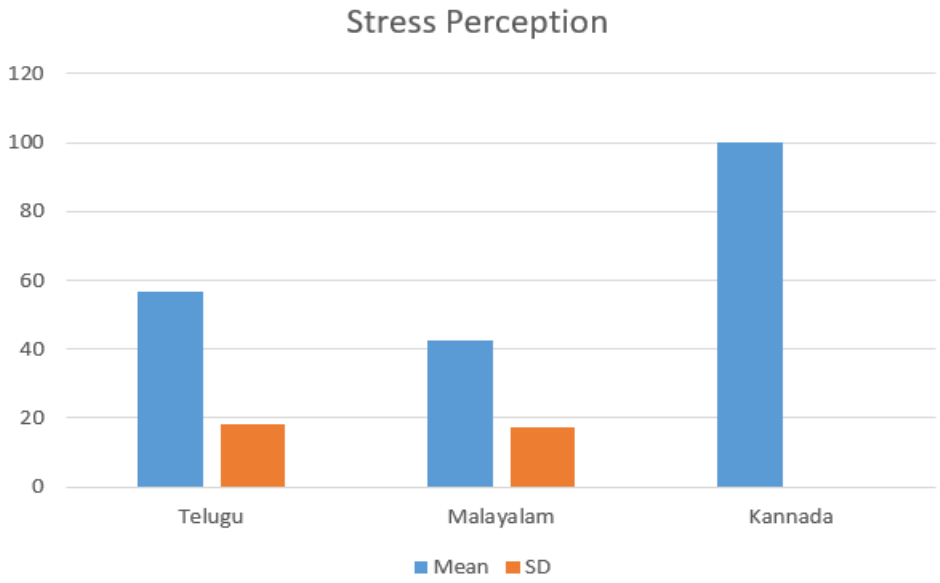


**Fig 1:** Shows the percentage of stress perception across languages

A one-way ANOVA showed a statistically significant difference in stress perception scores among the groups F(2,93)=133.99,p<0.001F(2,93) = 133.99, p < 0.001F(2,93)=133.99,p<0.001.

Post-hoc analysis using Bonferroni's multiple pairwise comparisons indicated that all groups significantly differed from one another.

The percentage of mean differences in stress perception scores between Telugu-Malayalam, Kannada-Malayalam, and Telugu-Kannada listeners were 14.38%, 57.5%, and 43.12%, respectively (see table 3 and Fig 2). These findings indicate that native Kannada listeners outperformed non-native listeners, while Telugu speakers had relatively better stress perception than Malayalam speakers.

**Table 3:** Shows percentage of mean difference (MD) between languages

| Language Pair | MD Percentage (%) |
|---|---|
| **Telugu-Malayalam** | 14.38 |
| **Kannada-Malayalam** | 57.5 |
| **Telugu-Kannada** | 43.12 |

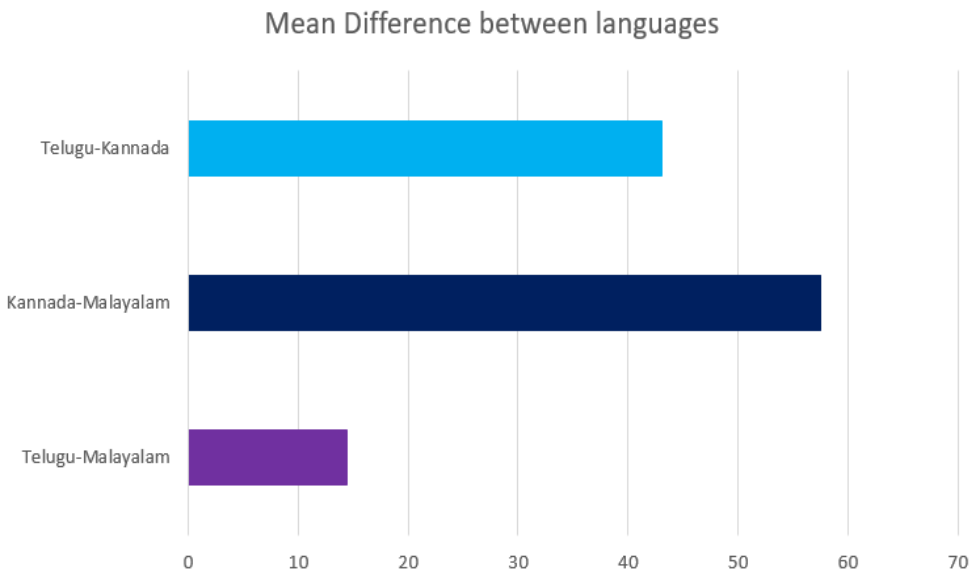


**Fig 2:** Shows the Mean Differences between languages

These findings suggest that non-native listeners performed considerably worse than native Kannada speakers, with the difference being more pronounced between Kannada and the other two languages than between Telugu and Malayalam. This aligns with previous research indicating that Kannada listeners rely heavily on vowel duration for stress perception, while Telugu listeners depend more on vowel length variations, and Malayalam listeners exhibit a multi-centric stress system with primary and secondary stress patterns. The lower scores of Malayalam listeners suggest that their reliance on multiple stress markers may have hindered their ability to perceive stress effectively in Kannada words. These results support the idea that stress perception is language-dependent and influenced by the phonetic characteristics of a listener's native language.

**Discussion**

Native Kannada speakers effectively utilized suprasegmental cues, with duration as the primary cue and Fo/intensity as secondary cues. Native Telugu speakers showed moderate stress perception abilities, primarily relying on vowel length for stress identification. Native Malayalam listeners exhibited the lowest performance, possibly due to the multi centric stress pattern in Malayalam, where primary and secondary stress components exist. The results align with past studies [29, 32] indicating that stress perception is largely language-dependent. Kannada speakers depend on vowel duration, while Telugu speakers focus on syllable length, and Malayalam speakers have a more complex stress pattern.

The results of the current study strongly suggest that cross-linguistic differences in stress perception are a result of the phonetic characteristics of each language. The perfect performance of native Kannada speakers can be attributed to their reliance on vowel duration, which is a prominent feature of their stress system. On the other hand, Telugu speakers showed moderate performance, possibly due to their focus on syllable length and vowel length, which shares some similarities with Kannada but is not as effective in perceiving stress contrasts in a second language. Malayalam speakers, who are accustomed to a more complex stress system that involves both primary and secondary stress, struggled more with Kannada stress, which is less varied and more predictable. These findings support the idea that stress perception is highly language-dependent

and influenced by a listener's native phonological system, as suggested by theories like the Stress Typology Model [11] and the Stress Deafness Model [10].

## Conclusion

The findings of this study emphasize the importance of understanding cross-linguistic differences in stress perception. As demonstrated, native speakers of Kannada, Telugu, and Malayalam showed varying degrees of proficiency in perceiving stress in Kannada, a second language for all participants. Kannada speakers excelled due to their reliance on vowel duration, while Telugu speakers performed moderately well, owing to their reliance on syllable length and vowel length, which partially overlapped with Kannada's stress system. However, Malayalam speakers faced greater difficulty due to the multi-centric stress system in their language, which may have hindered their ability to accurately perceive Kannada stress. These differences suggest that language instructors and speech therapists should consider a learner's native language stress patterns when developing teaching strategies or therapies for second language acquisition or stress perception training.

Authors of the current study concluded that the stress perception varies significantly among Kannada, Telugu, and Malayalam speakers, highlighting the impact of native language phonetics on stress recognition in a second language.

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**Acknowledgment**

The authors would like to express their sincere gratitude to all the participants.

**Conflicts of interests**

NO

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