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Familiar and Common Telugu Trisyllabic Words for Speech Perception Assessment: A Sociolinguistic Perspective

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Abstract;

The present study aimed to develop a set of familiar, common Telugu trisyllabic words that are socioculturally acceptable and linguistically appropriate, and that also meet the stimulus characteristics regarding acoustic-phonetic parameters for use in speech-perception assessment. A pool consisting of 255 trisyllabic words was gathered from different sources. They were subjected to a familiarity assessment to ensure they are known to and commonly used by native speakers of Telugu. This yielded a total of 195 words, categorised into three groups: most familiar, quite familiar, and fairly familiar. Experts in the relevant fields vetted these words to validate their sociocultural acceptability and linguistic appropriateness. The words that accumulated after validation were categorised into three groups: most appropriate, quite appropriate, and fairly appropriate words. These words were organised in a descending hierarchy based on the familiarity level of each word and its corresponding appropriateness level. Finally, these words were audio-recorded and perceptually evaluated by three experts to identify those that fulfilled the stimulus criteria needed for the intended speech perception measure. As a result, 104 words were identified that fulfilled the stimulus criteria and ultimately served as the foundation for developing speech stimuli for the intended speech perception measure.

Keywords: Trisyllabic Words, Familiarity Assessment, Content Validity, Speech Perception Assessment, Telugu

Introduction

Speech audiometry, a diagnostic hearing test, employs speech as test stimuli to assess a person's speech perception ability (Kramer & Brown, 2019). The conventional speech perception measures used as part of the speech audiometry include the speech recognition threshold (SRT), which is the threshold for recognising speech stimuli, which estimates auditory sensitivity to speech, and the speech identification score (SIS), which is the maximum identification score achieved for speech stimuli presented at optimal suprathreshold levels. SRT is the lowest intensity level in dBHL at which a person can accurately recognise 50% of the speech stimuli presented to him/her (ASHA, 1988). Every stage of the audiological test battery employs SRT estimation. The significance of SRT testing has been extensively documented: first, it acts as an indicator for validating pure-tone thresholds; second, it serves as a benchmark for determining suitable presentation levels when administering supra-threshold speech perception tests; third, it assesses the need for and effectiveness of rehabilitation devices, such as hearing aids, cochlear implants, etc.; fourth, it contributes tracking the prognosis of the rehabilitative approaches; and fifth, it ascertains the level of hearing sensitivity in young children and other hard-to-test persons (Gelfand, 2016). However, SRT must be measured routinely using appropriate speech stimuli suitable for different populations, taking each population's native language into account.

In English, SRT is measured by presenting disyllabic compound words in a spondee configuration. Conversely, spondee words are not commonly encountered in spoken language. A spondee is a musical metric foot containing two stressed syllables. A two-syllable unit in a poem pronounced with equal stress on both syllables is called a spondee or spondaic word. Hence, SRTs obtained with spondees as test stimuli are also considered spondaic thresholds. Although spondees are uncommon in spoken language, it is possible to pronounce disyllabic words with a spondee structure. Delivering disyllabic words with a spondee configuration maintains a constant amplitude across the syllables. Furthermore, disyllabic compound words consist of two morphemes, e.g., 'football' ('foot' and 'ball') and 'playground' ('play' and 'ground'). This enables them to function as redundant speech stimuli, with either the first or the second half of the compound word complementing the other to predict the entire word accurately. Thus, the nature of compound words and their pronunciation in a spondee configuration make it possible to predict words and estimate SRT at low-intensity levels accurately (Martin & Clark, 2019).

Telugu is a south-central Dravidian language. The majority of Telugu speakers reside in the Telugu states of India (Andhra Pradesh and Telangana). In addition to being the official language of Andhra Pradesh and Telangana, it is one of the 22 scheduled languages of India. It is also one of the official languages of the Union Territory of Puducherry, specifically in the Yanam region. Telugu speakers can also be found in nearby states, such as Tamil Nadu, Karnataka, Odisha, and Chhattisgarh. Telugu has the fourth-largest number of native speakers in India, with approximately 81.1 million speakers (Census of India, 2011). It also ranks fifteenth among the world's languages. From a sociolinguistic perspective, Telugu is viewed as a dynamic language that is socially embedded rather than

a single, monolithic entity. Various social factors, such as geography, culture, caste, class, gender, education, urbanisation, migration, language contact, etc., influence how Telugu is practised, differentiated, and regarded. Telugu, spoken in Telugu states, has four primary regional dialects: Rayalaseema, Kalinga, Central Coastal, and Telangana (Krishnamurty, 2003). Additionally, each Telugu dialect has subvarieties, likely due to differences in the sociocultural backgrounds of its native speakers. Hence, sociocultural and linguistic differences among native Telugu speakers should be taken into account when developing speech perception tests.

Kumar & Mohanty (2012) developed conventional wordlists, and Kumar et al. (2016) developed high-frequency wordlists to measure speech identification score (SIS) among native speakers of Telugu. Similarly, Sreedhar et al. (2011) developed wordlists composed of a large proportion of copulative compounds, and Kumar et al. (2016) developed wordlists composed of a large proportion of endocentric compounds to estimate the speech recognition threshold (SRT). However, the Telugu compound word lists developed for estimating SRT are composed of polysyllabic words. This is because compound words of disyllabic structure are scarce in Telugu, as the language tends to end in vowels. Further to the polysyllabic nature, most words had consonant sequences formed with clusters (geminate and nongeminate). Hence, aside from polysyllabic structure, the increase in the phonemic length of words due to consonant sequences likely enables them to serve as redundant speech stimuli. However, delivering polysyllabic words with equal stress across the syllables not only becomes harder but also results in uneven stress within the words. The difficulty in providing such words with equal stress rises even more when clusters accompany them. Hence, despite the words in the existing lists being socioculturally acceptable and linguistically appropriate, it is likely that these words would not fulfil the stimulus characteristics required for SRT estimation.

Consequently, it is hypothesised that trisyllabic words free of consonant sequences can serve as immediate alternatives to speech stimuli in Telugu for estimating SRT. Despite trisyllabic words not being considered true spondees, it is anticipated that they can be pronounced by forcing equal stress on them, approximating the spondee configuration. As a result, it is proposed that appropriate speech stimuli, comparable to spondees, that measure SRT be used. Hence, the present study aimed to establish a set of Telugu trisyllabic words that are familiar, commonly used, socioculturally acceptable, and linguistically appropriate to native Telugu speakers, while also meeting stimulus characteristics related to stress across syllables, as needed to estimate SRT in Telugu.

Materials and Methods

A pool of Trisyllabic words in Telugu was collected from multiple sources. This comprised a greater proportion of words in the CVCVCV structure (220 words) than in the VCVCV structure (35 words), for a total of 255 words. They were assessed for familiarity to ensure they are known to and commonly used by native speakers of Telugu despite differences in their dialectical and regional backgrounds. These words were assessed for content validity to ensure they are socioculturally acceptable and linguistically appropriate. Furthermore, they were evaluated according to stimulus criteria crucial for estimating SRT.

Familiarity Assessment

120 native speakers of Telugu from different regional dialects of Telugu-speaking states (Telangana and Andhra Pradesh), including Telangana, Central Coastal, Rayalaseema, and Kalinga, participated. They were between 20 and 30 years of age. They had at least 12 years of education. They were equal in number, gender (male vs female), and geographical background (urban vs rural), considering the regions of the Telugu states to which they belonged. An interaction session was arranged with the participants. The pool of trisyllabic words was delivered to them. They were asked to rate them on a five-point scale from most familiar to unfamiliar. The participants were provided enough opportunity to address any doubts they may have had about the words and ratings. They were given one week to complete the familiarity ratings.

Each participant performed a word-wise rating. After participants completed the ratings, a second interview session was held to review them. Their concerns were addressed if the participants had doubts about the ratings of particular words. After addressing their concerns and doubts, they were given enough time to complete them. The second interview session helped to increase the accuracy of the participants' ratings. The authors scored each word on a five-point rating scale based on the participants' ratings, which ranged from 0 to 4. The words rated as most familiar, quite familiar, fairly familiar, less familiar, and unfamiliar received scores of 4, 3, 2, 1, and 0, respectively. A word-wise score was calculated from participants' ratings. Raw scores were computed to form a word-wise total score, which was then converted to a percentage, serving as the familiarity score (%) for each word. Based on familiarity scores (%), the words were grouped into three categories. The words with familiarity scores between 91% and 100%, 81% and 90%, and 71% and 80% were categorised as most familiar, quite familiar, and fairly familiar, respectively. Words with a familiarity score of 70% or lower were considered less familiar or unfamiliar and excluded from the pool. The remaining words were listed in descending order, based on familiarity scores (%) for each category. These words were assessed for content validity.

Content Validity

Content validity refers to the degree to which the measurement technique measures what it is expected to measure, i.e., to examine how the words from the familiarity assessment satisfy the requirement for the intended speech perception measures (Schiavetti & Metz, 2002). Fifteen experts from the relevant fields evaluated the

words established from the familiarity assessment. They were asked to validate the words considering the familiarity levels, sociocultural acceptance, and linguistic appropriateness for the intended speech perception measure. The experts validated the words on a five-point scale, ranging from most appropriate to inappropriate. Each expert performed a word-wise validation. The authors scored each word on a five-point rating scale, based on the experts' ratings, ranging from 0 to 4. The words rated as most appropriate, quite appropriate, fairly appropriate, less appropriate, and inappropriate received scores of 4, 3, 2, 1, and 0, respectively.

A word-wise score was calculated from expert ratings. Raw scores were computed to form a word-wise total score, which was then converted to a percentage, serving as the appropriateness score (%) for each word. The appropriateness levels of the words were grouped into three categories concerning the appropriateness score (%): most appropriate, quite appropriate, and fairly appropriate. The words with appropriateness scores between 91% and 100%, 81% and 90%, and 71% and 80% were categorised as most appropriate, quite appropriate, and fairly appropriate, respectively. Words with an appropriateness score of 70% or lower were considered less appropriate or inappropriate and excluded from the pool. A final list of these words was compiled in a descending hierarchy, considering each word's familiarity level and its corresponding appropriateness level.

The list of words obtained through content validity was audio-recorded by an adult female native speaker of Telugu, a speech-language pathologist and audiologist, and a professional voice user. The audio recording was performed in a quiet, acoustically treated booth, with a high-fidelity microphone placed 10 cm from the speaker's mouth. The speaker was asked to articulate each word clearly by maintaining equal vocal emphasis and effort across the word's syllables, mimicking a spondee configuration. The word waveforms were digitised at a sampling rate of 44 KHz using a 16-bit analogue-to-digital converter housed within the computer. Three experts perceptually evaluated the audio-recorded words for their acoustic-phonetic parameters to determine whether they met the stimulus requirements for the intended speech perception measure (i.e., SRT). As a result, they identified 104 words that maintained equal stress across syllables and approximated a spondee configuration.

Results and Discussion

A pool of trisyllabic words constituted 255 words. A familiarity assessment reduced them to 195 words. The word familiarity levels were categorised into three groups based on their familiarity scores (%): most familiar (159 words), quite familiar (18 words), and fairly familiar (18 words). Following the content validity process, the result was 145 words. The appropriateness levels of the words were categorised into three groups, based on appropriateness score (%): most appropriate (125 words), quite appropriate (10 words), and fairly appropriate (10 words). A list of these words was compiled in a descending hierarchy, with each word's familiarity and corresponding appropriateness levels documented. When these words were judged for stimulus-delivering criteria (i.e., mimicking spondee configuration) required for estimating SRT, 104 words fulfilled the criteria. These words serve as a foundation for constructing wordlists to estimate SRT among native Telugu speakers.

Speech perception assessment involves reliable and valid measurement procedures appropriate for various populations concerning their native language. The present study aimed to develop Telugu trisyllabic words to create word lists for estimating SRT among native speakers. It is well recognised that a person's speech perception abilities are primarily determined by the physiological functioning of their auditory mechanism. However, differences in the sociolinguistic backgrounds of native speakers of the concerned language should not be overlooked, as they can affect speech perception assessment (Kumar et al., 2016). Most people in the Indian states of Telangana and Andhra Pradesh speak Telugu as their mother tongue. The boundaries of the Telugu states have been drawn based on the language spoken within them. Still, they are further divided into regions mainly based on regional dialects. Further, each regional dialect of Telugu has subvarieties likely due to differences in its sociocultural context. As a result, some words commonly used in one region of Telugu may not be used by native speakers from other areas, and they may be unfamiliar to them. Test words are generally expected to become more intelligible to individuals when they are more familiar with those words (Luce & Pisoni, 1998). Hence, the trisyllabic words collected from various sources were assessed for familiarity to ensure that native speakers of Telugu were familiar with and commonly used them, regardless of regional and dialectal differences.

Before conducting the familiarity assessment, the authors excluded words with consonant sequences (geminate and nongeminate clusters) from the initial pool. It becomes harder to deliver words with clustered and geminated syllables with equal stress across the syllables, resulting in uneven amplitude within the words and affecting the stimulus-delivering criteria needed for estimating SRT. Despite we intended to develop trisyllabic words phonetically in the CVCVCV form, words phonemically in the VCVCV structure, beginning with front vowels /i/, /i:/, /e/, and /e:/, and back vowels /u/, /u:/, /o/, and /o:/, phonetically semi-glides were included. In Dravidian languages, especially in Telugu, the palatal glide precedes the words beginning with front vowels, and a labial glide precedes back vowels (Pandey & Sounds, 2014). For example, the words /eluka/ 'rat', /iʈuka/ 'brick', /okaʈi/ 'one', and /uɖuʈa/ 'squirrel' are spoken as [yeluka], [yiʈuka], [wokaʈi], [wuɖuʈa], respectively, in Telugu. Therefore, the exclusion of words with consonant sequences and the inclusion of words beginning with phonetically semi-glides were intended to develop a pool of trisyllabic words that are phonetically uniform.

Based on the familiarity assessment, words were grouped into most familiar (91-100%), quite familiar (81-90%), and fairly familiar (71-80%) categories, based on their familiarity scores (%). It was observed that some words known to most native speakers are spoken differently in the respective regions to which they belong. The words

/d͡ʒalubu/ ‘cold’, /emuka/ ‘bone’, and /d̪uraḍa/ ‘itching’ spoken in the Central Coastal region are known to most people despite differences in their regional backgrounds. However, they are spoken differently across regions; e.g., the word /d͡ʒalubu/ is spoken as /sard̪i/ and /paɖiʃam/ in the Telangana and Rayalaseema regions, respectively. The word /emuka/ is spoken as /d̪ummu/ and /bokka/ in the Kalinga and Telangana regions, respectively; the word /d̪uraḍa/ is spoken as /gokuɖu/ and /nusi/ in the Telangana and Kalinga regions, respectively. Still, the words /d͡ʒalubu/, /emuka/, and /d̪uraḍa/ received familiarity scores of 81%–90%, placing them in the "quite familiar" category. This is because, although they are spoken differently in other Telugu regions, most people are familiar with them. Hence, they may be considered a secondary choice of words for speech perception assessment.

In contrast, some words spoken in one region are not only spoken differently in other areas but are also unfamiliar to them, despite being native speakers of the same language. The word /ba:ɖuga/ ‘rent’, spoken in the Rayalaseema region, is unknown to most people in the Kalinga, Telangana, and Central Coastal regions. Hence, the word received a lower familiarity score and was placed in a less familiar category. It is spoken /add̪e/ in the Kalinga and Central Coastal regions, and /kira:ji/ in the Telangana region. Similarly, the word /kira:ji/ ‘rent’, spoken in the Telangana region, is known to most people in the Rayalaseema, Kalinga, and Central Coastal regions despite not being regularly used. Hence, the word fell under the quite familiar category. As a result, native speakers of different regional dialects likely perform speech perception tasks differently, depending on their familiarity with words from other dialects. Hence, employing words with lower familiarity levels must be avoided as speech stimuli in speech perception assessment. Thus, the words that received familiarity scores of 70% or below were placed under either the less familiar or unfamiliar categories. They were excluded from the pool.

Despite native speakers of a particular language accepting certain familiar and common words in their sociocultural contexts, the exact words may be unacceptable to native speakers of the same language in other contexts due to differences in their sociocultural backgrounds. Sometimes, the words may be offensive, sensitive, and derogatory to native speakers of specific sociocultural backgrounds. Hence, the words resulting from the familiarity assessment underwent content validity testing to assess their sociocultural acceptability and linguistic appropriateness. The experts counterbalanced the words to account for the disparities in the dialectical and sociocultural backgrounds of the native speakers. In this process, the experts identified words from the pool that are inappropriate for native speakers from specific sociocultural backgrounds. Such words received either less appropriate or inappropriate ratings and were excluded from the pool. The experts subsequently assessed the words for linguistic appropriateness. They excluded bound morphemes and proper names, selected borrowed words, and words not phonetically in the CVCVCV form. Based on content validity, we established three categories: most appropriate (91–100%), quite appropriate (81–90%), and fairly appropriate (71–80%).

Assessments of familiarity and content validity revealed that the familiarity levels of most words matched their appropriateness levels. However, some words with the most familiar and quite familiar ratings received either less appropriate or inappropriate ratings. The borrowed words that likely interfere with the phonotactic nature of Telugu (vowel ending nature) received either less appropriate or inappropriate ratings, e.g., the final consonantal phonemes in words, /ka:leɟi/ ‘college’, /pe:paru/ ‘paper’, and /a:phi:su/ ‘office’, etc., are largely unreleased. Hence, the experts recommended excluding such words. Despite some words in Telugu that have /m/ and /j/ in the final consonantal position being phonemically in CVCVCV form, phonetically they are unreleased, e.g., the words /va:ramu/ ‘week’, /rasamu/ ‘juice’, /ru:pa:ji/ ‘rupee’, and /ba:ba:ji/ ‘uncle’ are spoken as [va:ram], [rasam], [ru:pa:j], and [ba:ba:j], respectively. Hence, experts considered such words either less appropriate or inappropriate. Although aspiration is not regarded as phonemic in Telugu, except for borrowed words, there is a risk of clinician bias when delivering such words during speech perception assessments. Having a few test words with aspirated phonemes in lists likely alters the uniformity of stimulus presentation rhythm during speech perception assessment. Hence, the words formed with aspirated phonemes were considered less appropriate or inappropriate for the intended speech perception measure.

Nonetheless, in addition to fulfilling the sociocultural and linguistic requirements, the words should also meet the stimulus requirements (equal stress across syllables). Stress is not only associated with amplitude but also with syllable duration and fundamental frequency (Ying, Jamieson, Chen, Michell, 1996). Further, it was reported that syllable duration and fundamental frequency are dominant acoustic parameters contributing to stress (Albin & Echols, 1996). The syllable duration, fundamental frequency, and amplitude should be consistent throughout the syllables of each word to maintain equal stress. The stressed syllables seem to assist better in phoneme recognition than unstressed ones (Cutler & Foss, 1977). Likewise, when the syllables within the words are pronounced with equal stress, the words are not just perceived better but also at low intensity levels. Hence, the audio-recorded words were perceptually judged by three experts, one after another, on whether they maintain equal stress throughout the syllables of each word and approximate spondee configuration. As a result, 104 words fulfilled the stimulus criteria for estimating SRT and served as a foundation for constituting wordlists. It was observed that the words that contained only short vowels in every syllable of trisyllabic words fulfilled the stimulus criteria. It may be possible to maintain consistent amplitude, syllable duration, and fundamental frequency, resulting in equal stress across the syllables in the words /ṭa̪-lu-pu/ ‘door’, /pe-ru-gu/ ‘curd’, /gu-ṭa-ka/ ‘sip’, /po-ga-ru/ ‘arrogance’ that contained short vowels in every syllable. In contrast, it may be challenging to maintain consistent amplitude, syllable duration, and fundamental frequency, resulting in uneven

stress across the syllables in words /ɖe:-vu-ɖu/ 'god', /sa-ma:-ɖi/ 'tomb', /sa-ra-ɖa:/ 'fun', /mo:-ka:-lu/ 'knee' that contained one long vowel and two short vowels or two long vowels and one short vowel.

In summary, trisyllabic words are easier to perceive than disyllabic and monosyllabic words. Increasing the number of syllables within a word provides rich contextual cues derived from possible syllabic combinations. Hence, the trisyllabic words established in the present study are expected to serve as redundant speech stimuli. Despite these trisyllabic words not being considered true spondees, they were found to be pronounced with equal stress across syllables and approximated spondee configuration. Hence, it is proposed that appropriate speech stimuli, comparable to spondees, that measure SRT be used. As a result, trisyllabic words may be immediate alternatives to spondees in Telugu. In addition to meeting the stimulus criteria, the wordlists should maintain inter-list equivalence to estimate an accurate SRT. Therefore, the words across the lists should be equally intelligible to achieve inter-list equivalency. In general, the equivalency of test words across lists likely remains uniform when word recognition testing is performed in quiet listening conditions on individuals with normal hearing sensitivity—a ceiling effect might obscure inter-list equivalency. However, speech perception assessments are also conducted in noisy listening conditions. As a result, the equivalency of words does not remain uniform when word recognition testing is done in the presence of background noise (Chermak et al., 1988; Gengel et al., 1981; Loven & Hawkins, 1983). Hence, to overcome the ceiling effect, words that meet the stimulus criteria for estimating SRT should be tested on native speakers in a noisy listening condition to ensure they are equally intelligible. Hence, a pilot study is recommended to establish words that are equally intelligible before constituting psychometrically equivalent word lists intended to measure SRT.

Conclusions

A pool of 145 words, comprising familiar, common, socioculturally acceptable, and linguistically appropriate words to native speakers of Telugu from diverse dialectal and regional backgrounds, was established through a familiarity assessment and content validity. When these words were audio-recorded and perceptually evaluated, 104 words met the stimulus criteria needed for SRT measurement. These words serve as a foundation for constituting wordlists for SRT estimation. However, a pilot study is recommended to establish words that are equally intelligible before creating psychometrically equivalent wordlists for SRT measurement. Further investigations are required to examine the applications of developed wordlists for diagnostic and rehabilitative purposes of different auditory disorders. The wordlists can be further modified to assess speech-perception challenges in individuals with (central) auditory processing disorders. Besides all, the applications of such wordlists can be extended to the emerging field of cognitive hearing science.

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