Auditory and Vestibular Research

Examining the Validity and Reliability of Persian version of Speech Prosody Comprehension Test in Children".

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Highlights:

- The P-SPCT showed high validity and reliability, with a face validity index of 88.75%
- Strong correlations between subscales (0.72 > r < 0.76) confirmed construct validity
- The test significantly differentiated between normal hearing and CI children

Abstract

Background and aim: Speech prosody, the nonlinguistic elements of speech that convey emotions, is crucial for social interactions and speech comprehension. This study aimed to investigate the Validity and reliability of the Speech Prosody Comprehension Test (SPCT) for Persian-speaking children aged 7-10.

Method: The Persian version of the Speech Prosody Comprehension Test (P-SPCT) was investigated. Face, construct, and discriminant validity, Test-retest reliability, and Internal consistency were examined on 32 children in age 7-10 with 22 (mean age ± SD = 8.63 ± 1.04) normal hearing and 10 (mean age ± SD = 9.20 ± 0.78)with cochlear implant)CI).

Results: Our result demonstrated good face validity. Construct validity revealed strong correlations in intra-sub score items and between subscales and the total score. A significant difference in mean scores was found between normal hearing and cochlear implant user, supporting discriminant validity (P<0.001). High test-retest reliability was demonstrated, with intraclass correlation coefficients (ICCs) ranging from 0.91 to 0.99 for total and all subscales. The measure demonstrated good internal consistency, with a Cronbach's alpha 0.89 for total score.

Conclusion: The Persian version of Speech Prosody Comprehension Test was found to be a valid and reliable clinical tool for assessing speech prosody comprehension in children aged 7-10. Further research with larger samples can confirm the generalizability of these findings.

Keywords: Speech Prosody Comprehension Test, children, Validity, Reliability, Cochlear implant, Speech prosody

Introduction

Emotional communication is a complex process involving mutual influence between communication partners' emotions [1]. It plays a crucial role in social interactions, providing information about others' states and guiding behavioral responses. Emotional speech prosody refers to the nonlinguistic aspects of speech that convey emotional information. It plays a crucial role in decoding social interactions and adapting to contextual cues [2]. Research has shown that prosody and semantics are separate but intertwined channels in emotional speech perception, with prosody often dominating [3]. Emotional speech is characterized by variations in acoustic features, such as fundamental frequency (F0), intensity, and duration. Emotions like happiness and anger are often associated with higher F0 and increased intensity, while sadness may exhibit lower F0 and reduced intensity. Duration changes also significantly contribute to the emotional expression of speech. [4].Research indicates that emotional speech prosody assessment is crucial for hearing-impaired children, studies on emotional speech prosody in hearing-impaired children reveal that CI users face challenges in perceiving and producing emotional and linguistic prosody due to inadequate transmission of f0 cues, and reliance on semantic information [5–8]. Factors such as chronological age, duration of speech-language-auditory training, and language age positively correlate with prosody perception scores [9]. Hearing age is also a predictor of prosody-based response accuracy [10].

Efforts have been made to develop valid and reliable tests for prosody comprehension, such as the Emotional Prosody Measurement (EPM) method. The EPM has been used to evaluate the effectiveness of psychological therapies [11]. Another study developed the Persian version of the Speech Prosody Comprehension Test (P-SPCT), specifically designed for Persian speakers. The validity and reliability of this test were examined in a Persian-speaking population aged 18-60 years [12]. Considering the importance of investigating the role of prosody in children, especially with CIs, the aim of this study was to assess the validity and reliability of the P-SPCT in 7-10-year-old Persian-speaking children.

Methods

Persian version of speech prosody comprehension test by Torke Ladani et al.,developed on 32 normal adults aged 18-60 years was selected as a well-validated test Click or tap here to enter text.. In which researchers have utilized the Florida affect battery (FAB) as a model for constructing a speech prosody comprehension test. FAB consists of three different parts: speech prosody, facial expressions, and the interaction between facial expressions and prosody. Troke Ladani et al. study focused primarily on the FAB prosody component [12].

Procedure

The SPCT consists of four subtests: non-emotional prosodic discrimination (Comprises 16 tasks, each consisting of two sentences spoken by a single speaker(. The sentences are presented two seconds apart. The prosody (intonation and stress) of each sentence is either identical or different. In this part, the child is asked to listen to each pair of sentences and indicate whether the prosody of the sentences is the same or different), Emotional prosodic discrimination (Consists of 36 tasks(. Each task includes two sentences spoken by a single speaker. The emotional prosody of each pair of sentences is either the same or different. In this section, the listener is asked to listen to each pair of sentences, with each sentence separated by a two-second interval, and to determine whether the emotional prosody is the same or different), Naming (Consists of 32 tasks, each task including one sentence that is spoken in eight different tones. The time interval between sentences is four seconds. In this subtest, a list of target tones is provided to the listener, and they are asked to listen to each sentence and identify the tone of each one based on the provided list), and Naming Contradiction (Consists of 36 tasks. Each task includes one sentence. The sentences are expressed both similarly and oppositely in terms of their semantic load. In this subtest, the individual is asked to name the tone of the sentence without paying attention to the content of the sentence).

Participants

The participants were 32 children aged 7-10 years. Twenty-two had normal hearing (pure tone threshold <25 dB for octaves at 250–8000 Hz frequency) [18], normal speech recognition thresholds (<25 dB HL), while ten had unilateral cochlear implantation on the right side with a MED-EL prosthesis. These children underwent surgery before the age of three and had profound sensorineural hearing loss.

in the opposite ear. All participants had normal intelligence (IQ ≥ 85) based on the Wechsler Intelligence Test, were monolingual Persian speakers, and had parents who provided written informed consent. Participants were excluded if they were unwilling to continue participating. The study was approved by the Human Research Ethics Committee of Tehran University of Medical Sciences (No: IR.TUMS.FNM.REC.1402.148).

Psychometric evaluation

Face validity was established through a qualitative assessment. Six experts in audiology, independently evaluated the P-SPCT. Experts assessed the test's clarity, appropriateness for the target age (7-10 years), and cultural relevance. All experts rated the test positively, indicating good face validity.

Construct validity was examined by analyzing item correlations. This included examining correlations within and between subscales and correlations between each item and the total score.

Discriminant validity was assessed by comparing the mean scores of the Speech Prosody Comprehension Test between children with normal hearing and those with cochlear implants

Test-retest reliability was assessed by administering the Speech Prosody Comprehension Test to all participants twice with a two-week interval. Intraclass correlation coefficients (ICCs) were calculated to estimate test-retest reliability. Test-retest differences were also calculated and analyzed to further evaluate the consistency of scores over time.
Internal consistency reliability was assessed using Cronbach's alpha coefficient to determine the extent to which the items on the test measure the same underlying construct.

Statistical analysis

Data were analyzed using SPSS (Version 17.0, SPSS Inc., Chicago, IL, USA). Normality of the data was assessed using the Kolmogorov-Smirnov test. The results indicated that the data were normally distributed ($p > 0.05$). Face validity was assessed for each item using descriptive statistics. The construct validity was tested by Spearman correlation. For measuring discriminative validity, we used t-test to compare the mean scores of Speech Prosody Comprehension Test between groups. Test-retest reliability was assessed with 2-weeks interval in all participants and reported as an ICC, according to established guidelines, an ICC greater than 0.75 indicates excellent reliability, 0.6-0.75 good, and 0.4-0.59 fair [20]. Internal consistency was evaluated by Cronbach's alpha, with values between 0.7 and 0.95 considered indicative of high reliability [19].

Results

Characteristics of study population

A total of 32 individuals participated in this study, comprising 19 males (59.3%) and 13 females (40.6%). The mean age was 8.81 ± 0.99 years (range: 7-10 years). The sample included 22 children with normal hearing (pure tone threshold <25 dB for octaves at 250-8000 Hz frequency; mean age ± SD = 8.63 ± 1.04) and 10 children with cochlear implants (mean age ± SD = 9.20 ± 0.78).

Face validity

All Experts confirmed the clarity of it and reported good Face Validity Index= 88.75. Experts suggested minor adjustments, such as modifying the intensity balance and item arrangement, to ensure random assignment. These suggestions were implemented.

Construct validity

Spearman correlation analysis revealed strong correlations between intra-sub score items ($0.72 > r < 0.76$, $p < 0.001$). were also observed between subscales and the total score ($0.85 > r < 0.92$, $p < 0.001$).

Discriminative validity

P-SPCT between two groups of normal hearing and cochlear implant user showed significant differences in total score and sub scores. (Table 1)

Reliability

High Intraclass correlation coefficient were found for the total score (ICC = 0.99, 95% CI = 0.98 to 0.99, $p < 0.001$), for non-emotional (ICC = 0.91, 95% CI = 0.83 to 0.95, $p < 0.001$), emotional (ICC = 0.97, 95% CI = 0.95 to 0.98, $p < 0.001$), naming (ICC = 0.97, 95% CI = 0.95 to 0.98, $p < 0.001$), and naming contradiction scores (ICC = 0.95, 95% CI = 0.91 to 0.97, $p < 0.001$).
A paired t-test revealed no statistically significant difference between the test and retest total scores (mean difference ± SD = 0.75 ± 1.96, CI = 0.04 to 1.45, $p = 0.078$), non-emotional (mean difference ± SD = 0.18 ± 0.82, CI = -0.10 to 0.48, $p = 0.206$), emotional (mean difference ± SD = 0.40 ± 0.91, CI = 0.07 to -0.73, $p = 0.067$), naming (mean difference ± SD = 0.15 ± 1.08, CI = -0.23 to 0.54, $p = 0.420$), and naming contradiction (mean difference ± SD = 0.15 ± 1.19, CI = -0.27 to 0.58, $p = 0.465$).

Internal consistency

P-SPCT demonstrated high internal consistency, with Cronbach's alpha values of 0.89 for the total score, 0.83, 0.78, 0.75, 0.77 respectively for non-emotional, emotional, naming, and naming contradiction scores subscale.

Discussion

The present study aimed to investigate the psychometric properties of the P-SPCT in a pediatric population. This test designed to assess children's ability to recognize and interpret emotional cues conveyed through vocal tone, was administered to a group of 32 children in the age range of 7-10 years old, including both those with normal hearing and those with cochlear implants. The results of the study demonstrate that P-SPCT possesses strong psychometric properties in this population. Face validity was confirmed through positive ratings from participants regarding the clarity and appropriateness of the test. Construct validity was supported by significant correlations between intra-subscore items and between subscales and the total score. Content validity was established through expert ratings, with all items deemed essential and relevant for assessing the construct. Discriminative validity was evident in the significant differences between the P-SPCT scores of children with normal hearing and those with cochlear implants. Internal consistency was high, as indicated by Cronbach's alpha values, and reliability was demonstrated through high ICC and the absence of significant differences between test and retest scores.

The mean ± SD for the Speech Prosody Comprehension Test scores in our study were lower than those reported by Torke Ladani et al [12]. High correlations were observed between the subscales and the total score in both our study ($0.85 > r < 0.92$, $p < 0.001$) and the study by Torke Ladani et al. ($0.77 > r < 0.93$, $p < 0.001$)[12] .

Our study demonstrated high intraclass correlation coefficient for the total score (ICC = 0.99, 95% CI = 0.98 to 0.99, $p < 0.001$) and all subscales (non-emotional: ICC = 0.91, emotional: ICC = 0.97, naming: ICC = 0.97, naming contradiction: ICC = 0.95). These findings are consistent with the high ICCs reported by Torke Ladani et al. (total: ICC = 0.94, non-emotional: ICC = 0.81, emotional: ICC = 0.73, naming: ICC = 0.78, naming contradiction: ICC = 0.89) [12].

Speech prosody comprehension develops significantly during childhood, building upon foundational abilities established in infancy. Infants exhibit early sensitivity to prosodic cues, demonstrating preferences for emotional prosody over neutral tones. This early sensitivity forms the basis for later language development [13]. Furthermore, neural entrainment plays a crucial role, enabling infants to predict and process the rhythmic patterns of speech [14]. Toddlers begin to use prosody to parse speech into syntactic units, demonstrating early sensitivity to prosodic patterns [15]. This ability continues to develop as children progress through preschool (ages 3-5), where they start to decode emotional prosody in their native language, with skills gradually improving. By school age (6-8 years), children refine their ability to recognize and use prosody for pragmatic purposes, such as expressing emotions and intentions [16].While children demonstrate early sensitivity to prosody, full adult-like proficiency in comprehending and utilizing prosody for various communicative functions continues to develop throughout childhood and adolescence.

Research has consistently demonstrated the significant role of prosody in reading comprehension and language processing. Text reading prosody and speech prosody independently contribute to children's reading comprehension, with phrasing emerging as a particularly crucial factor [17]. Prosody plays a vital role in various aspects of language processing, including word recognition, syntactic structure computation, and discourse processing [18]. P-SPCT offers a valuable tool for assessing children's ability to understand and utilize prosody. It can be used to identify children who may be struggling with speech prosody comprehension, allowing for early intervention. By pinpointing specific areas of difficulty, this test can help clinicians design tailored interventions to address deficits in speech prosody comprehension. And also, can be used to track the progress of children who are receiving interventions, providing valuable feedback on the effectiveness of treatment.

Limitations

The sample was restricted to children aged 7-10 years with normal hearing or unilateral cochlear implants. Therefore, the generalizability of the findings to children with other hearing conditions, such as those with bilateral cochlear implants or those using hearing aids, may be limited. Furthermore, the study focused on a specific age range, and the findings may not be directly applicable to younger or older children.

Further Studies

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Future research should investigate the psychometric properties of the P-SPCT in a more diverse sample, including children with various hearing conditions, different age groups, and children from different cultural and linguistic backgrounds. Additionally, longitudinal studies are needed to investigate the developmental trajectory of speech prosody comprehension in children with different hearing profiles, and to examine the impact of early intervention and rehabilitation on their prosodic abilities. This research could also be expanded to explore the relationship between speech prosody comprehension and other language and cognitive skills in children with hearing loss.

Conclusion

In our study, the speech prosody comprehension test proved to be a valuable tool for assessing speech prosody comprehension in children. Its strong psychometric properties and ability to differentiate between children with normal hearing and those with cochlear implants highlight its potential for clinical use and further research. Further research with larger samples can confirm the generalizability of these findings

Ethical Considerations

Compliance with ethical guidelines

This study was approved by Tehran University of Medical Sciences (No: IR.TUMS.FNM.REC.1402.148). All participants gave their informed consent prior to the administration of the study.

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Table 1: Comparison of mean (SD) of speech prosody comprehension test scores between normal hearing and CI children. (n=32)

Subscale	Normal hearing	Cochlear implant user	Mean difference (p-value)
non-emotional	10.91 (1.15)	7.80 (2.15)	3.10 (0.001)
emotional	28.95 (1.36)	21.19 (3.90)	7.85 (0.001)
naming	24.59 (1.59)	15.40 (4.69)	9.19 (0.001)
naming contradiction	27.95 (2.03)	20.20 (1.61)	7.75 (0.001)
Total	92.54 (5.67)	64.50 (6.75)	28.04 (0.001)