Adaptation and Validation of the Common Object Token Test to the Marathi Language and its Applicability to Pediatric Cochlear Implant Recipients

Kalyani Salve, Priyanka Endal, Nandini Dave Maingi[1], Neelam Vaid

BIG EARS, KEM Hospital, Pune, Mahartashtra, [1]MED-EL India Pvt Ltd., New Delhi, India

Abstract

Context: The Common Object Token (COT) test is used in clinical settings to assess the complex closed-set speech perception skills in children with hearing impairment. **Aims:** The translation, adaptation, and validation of the COT test for the Sinhalese language of Sri Lanka served as a model for the study presented here. The same procedure was used to adapt the original English-language test to the Marathi language of West India. The finalized Marathi version was tested on children with normal hearing (NH). Its applicability to pediatric Marathi-speaking cochlear implant (CI) recipients was demonstrated. **Materials and Methods:** The forward/backward translation method was used to translate the original English-language test into Marathi. The Marathi version was assessed, adapted, and finalized by healthcare professionals and teachers who are native Marathi speakers and competent speakers of the English language. The finalized version was administered to 100 children with NH (mean age: 5.6 years; range: 2.7–9 years). Sixteen recipients of CIs manufactured by MED-EL (Innsbruck, Austria) were tested with the finalized Marathi version (mean age: 7.5 years; range: 3.5–12.5 years). **Results:** The original English-language COT test was designed with two levels of subtests arranged in an order of increasing difficulty. The subtests of each level of the finalized Marathi version were shown to follow this arrangement, which could be observed from the test scores in both the children with NH and the children with CIs. A strong correlation between the total score and each subtest score for both levels 1 and 2 were found in both groups. Good internal reliability and consistency were observed in the group with NH for both test levels. **Conclusions:** The COT test was translated, adapted, and validated for Marathi by administering it to children with NH. The finalized Marathi version was easily administered to pediatric CI recipients. It is recommended as a standard, validated tool for assessing the speech perception of pediatric Marathi-speaking CI recipients.

Keywords: Cochlear implants, Common Object Token test, forward/backward translation, Marathi, pediatric assessment, speech perception, test adaptation

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Introduction

The Common Object Token (COT) test was originally developed in English by Plant and Moore; subsequently, the test was adapted by Anderson *et al*. for assessing the age-related closed-set speech perception skills of pediatric cochlear implant (CI) recipients, for whom English is a first language. The test is under the copyright of MED-EL GmbH (Innsbruck, Austria).[1,2]

There are two levels of subtests that start with simple motor tasks that become progressively more difficult. The test is suitable for children with profound hearing impairment who are aged ≥3 years. Children who have used their hearing device for less than two years can perform the motor tasks.[1]

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However, there are few standardized and approved translations of the COT test in other languages. The tendency until now has been to use informal translations in clinical settings where English is not necessarily a first, nor majority, nor official language. Thus, there is a need for standardized, adapted, validated translations of the COT test to ensure consistency in the test procedures that are implemented in and between

Address for correspondence: Mrs. Nandini Dave Maingi, MED-EL India Pvt Ltd., 505, Pragati House, 47–48 Nehru Place, New Delhi - 110 019, India.
E-mail: nandini.maingi@medel.com

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clinics. It would also enable reliable comparative studies across large study populations.

India has no official language, instead there are 22 majority languages according to the Eighth Schedule Constitution, 92nd Amendment, Act 2003 (Archive 2003).[3] Languages are regionalized, and each state has a majority or official language. Marathi is the 3rd most spoken language after Hindi and Bengali. It is predominantly spoken in the state of Maharashtra on the west coast of India. The most recent census recorded 83.1 million Marathi speakers.[4] The rate at which CIs are provided to adults and children with severe to profound hearing impairment in India has dramatically increased over the past decade. This is primarily due to an increase in awareness about hearing loss in the population, early screening and detection programs for infants, government funding schemes that significantly reduce the costs of receiving an implant, and improved post-implantation support to ensure correct CI use and rehabilitation that is beneficial to the CI user. Evaluating language development in pediatric CI recipients is crucial for monitoring their communication skills and for assessing whether additional support is required.

Test materials that have not been adapted to and validated in the local languages is not a problem unique to India. For instance, the Mandarin Early Speech Perception (MESP) test is an adaptation of the Early Speech Perception (ESP) test.[5] The ESP is a simple closed-set speech perception test that uses picturable words and is suitable for young CI recipients (aged ≥2 years) for whom English is a first language. The ESP consists of 4 subtests with tasks of increasing difficulty. Adaptation to the Mandarin language made it necessary to introduce two additional subtests to the finalized MESP: Subtest 5 for consonant perception and subtest 6 for tonal perception.

Zheng *et al*. was the first publication to report the use of the MESP test to evaluate Mandarin-speaking pediatric CI recipients in China.[5] At the time of its publication, there were almost 5000 pediatric CI recipients in China and habilitationists knew very little about the recipients' speech perception abilities. According to the authors, a lack of outcome assessment tools for Mandarin-speaking children was the main reason why habilitationists in China were not equipped to monitor and assist pediatric CI recipients' language development.

Just like the original ESP, the MESP has certain similarities and differences to the test procedures and setup of the COT test. Similarly to COT procedure, the test administrator must familiarize the child with the test procedure and materials before the start of formal testing. The MESP differs from the COT test in the tasks the child has to perform. During the formal MESP testing phase, the child is asked to point at pictures that appear on a computer screen while listening to recorded words played back from the computer.

For the purposes of translating, adapting, and validating a pediatric speech perception test to the Marathi language, the COT test was chosen for the following reasons: (1) It uses colorful toys; (2) it is useful for children who can complete closed-set tasks but are not (yet) able to do open-set tasks; (3) it requires a motor response instead of a verbal response; (4) it can be used to assess children with limited verbal communication skills; (5) its test/re-test reliability is well documented in the literature; (6) it can be used to track speech perception and language development over time.[1,2]

The COT test has been translated, adapted, and validated to Sinhalese, the majority language of Sri Lanka.[6] To the best of our knowledge, at the time of writing this paper, Jeyaraman *et al*. is the only study to have demonstrated the suitability of the COT test to pediatric Sinhalese-speaking CI recipients. Therefore, in the study presented here, the same study design and study procedures as described in Jeyaraman *et al*. were followed. The original English-language COT test was translated, adapted, and validated to the Marathi language.

The objectives of this study were to translate the original COT test from English into Marathi using the forward/backward method; to validate the finalized Marathi version by using it to assess the speech perception of children with normal hearing (NH); and, finally, to demonstrate that the finalized Marathi version is a suitable speech perception assessment tool for pediatric CI recipients with Marathi as first language.

Materials and Methods

Ethics

Ethical approval (dated June 6, 2016; EC No. 1605) was obtained from the KEM Hospital Ethical Committee Board with adherence to the Declaration of Helsinki.[7] Children who were unwilling to be assessed were excluded.

Participants

One hundred children (51 males and 49 females) with NH were recruited from three local Marathi-language primary schools. The mean chronological age at the time of testing of this group was 5.6 years, with a range of 2.5–9 years. The parents and teachers of each child were asked whether they thought the child had any learning and/or behavioral needs. The finalized Marathi version of the COT test was validated on this group of children.

Consent to enter school premises and to interact with the children were obtained from the school authorities. Informed written consent in Marathi was obtained from parents before the start of any study-specific procedures.

To demonstrate that the finalized Marathi version of the COT test is also suitable for testing the age-related closed-set speech perception skills of pediatric CI recipients, 16 children who wore CIs were recruited. The mean chronological age of this group was 7.5 years; age range was 3.5–12.5 years.

Test material

Transient Otoacoustic Emissions (TEOAE) (Madsen Accuscreen by Otometrics Natus, Taastrup, Denmark) were

used to screen for NH in children if wax was not observed to occlude the ear canal. In children for whom TEOAEs were not possible, screening pure tone audiometry (audiometer Madsen Micromate 304 by Otometrics Natus, Taastrup, Denmark) was used to determine NH. Children with elevated thresholds (>20 dB HL between 250 Hz and 8 kHz) were excluded from participating in the study, and parents and teachers were informed.

The Common Object Token test

The test materials consist of an instruction manual, score sheets, and collections of colorful toys and objects. The toy collection consists of one train and four sets of four different types of vehicles, i.e. four cars in four different colors, four helicopters in four different colors, four airplanes in four different colors, and four boats in four different colors. The four colors are red, blue, green, and yellow. The collection of objects is a set of four circles in red, blue, green, and yellow. These colorful circles were used to test for color blindness. Figures 1 and 2 shows photos of the toys and objects.

The original COT test was designed to have two levels of testing. Level 1 consists of three subtests arranged in an order of increasing difficulty, i.e. subtest 1 is the easiest and subtest 3 is the most difficult. Level 2 consists of six subtests that are also arranged in an order of increasing difficulty. Each sentence is an instruction that requires a motor response in the form of an action, e.g. "Point to the blue boat." If the child performed the task correctly, the child received one point. If the child did not perform the task correctly, the child received a score of zero.[6] Each subtest yields a maximum score of ten, therefore, the final cumulative score on level 1 is out of 30 and out of 60 on level 2.

Adaptation of the common object Token test to Marathi

The procedures outlined here for the translation and adaptation of the COT test to Marathi are the same as the procedures that were followed by Jeyaraman *et al*. (2016) and Zheng *et al*. (2010) for translating and adaptating English-language speech perception tests to other languages: the COT test for Sinhalese (Jeyaraman *et al*. [2016]); the ESP for Mandarin (Zheng *et al*. [2010]).

The COT test was translated into Marathi using the forward-backward translation method, which is considered best practice by the International Test Commission (ITC).[8] The original English version served as the base version of the test. The English-to-Marathi forward translation was done by a speech and language pathologist and an audiologist. Both professionals are competent speakers in both languages, and they have experience working with children. The test score sheets and words for the collections of toys and objects used in the test were also translated into Marathi. The Marathi-to-English back translation was completed by a professional translator of an accredited translation company. The entire translation process was overseen by the authors of this paper.

The base (i.e. the original) and back-translated English versions were compared by the translation team and a Marathi version was agreed upon. It was decided that the Marathi words for car, helicopter, and train required greater consideration because the English words are more commonly used in daily life than the Marathi words. Thus, the English words "car," "helicopter," and "train" were not translated and were used in the finalized Marathi version of the test.

A team of professionals, who were not part of the translation team, were selected to assess the finalized Marathi version: a special educator, a professional translator (who did not translate the original test), a speech and language therapist, two audiologists, and two Marathi-speaking primary school teachers. This assessment team compared the finalized Marathi version to the original English test. The extent to which words and expressions held the same meaning in the two versions were assessed. The same sentence-wise rating scale was used in our study as in the adaptation and validation of the COT test to the Sinhalese language.[6] The three-point rating scale was as follows:

- "1": Not an appropriate translation; change is required
- "2": Not an exact translation, but no change is required
- "3": An appropriate translation and no change required.

The team were given an evaluation form to ensure systematic assessment. The evaluation forms were compared and discussed by the assessment team. Suggestions were taken for words and phrases that scored "1" and "2." Final agreements were reached on the words that caused concern: "Car," "helicopter," and "train." As already mentioned, the English words were used in the Marathi. For the full detailed Marathi COT test and the finalised scores sheets in Marathi that the test administrators used to document the children's performance please contact the journal.

Procedure for administering the Marathi version

The finalized Marathi version was administered at three primary schools where Marathi is the language of instruction. The test administrators chose a room on the school premises for conducting the test. Factors such as exposure to traffic noise (i.e. background noise) from a nearby road and whether the room was furnished with fabrics to minimize reverberance were considered in choosing the room. Tests were conducted at times during the school day when the ambient noise levels are expected to be low: tests were not conducted during lunch breaks, but rather at times when the rest of the school children were indoors and receiving instruction.

The test was administered by a habilitationist who is fluent in Marathi, who spoke the content of the test material, and had to adhere to the test procedure. The test protocol requires that the habilitationist briefly assess each child for their familiarity with the colors and toy objects that appear in the test. The habilitationist asked the child to randomly pick up or point at the toys. According to the test protocol, if a toy and/or color are not known to a child, the toy and/or color are eliminated from the test battery. The assurance of the child's knowledge is a key step in the procedure and is performed at the start of the test for every child, regardless of their educational background

or any other socio-economic factors, e.g. growing up in a rural or urban setting.

The children were tested individually. The child entered the room and was seated in front of a table where the colored toys were laid out in a matrix as described in the test's instruction manual. The habilitationist who administered the test was seated next to the child, so that the habilitationist had a side-on view of the child. The habilitationist asked the child to remain seated and to look at the toys so that the child had a face-on view of the toys. This configuration minimized visual cues throughout the test procedure.

A sound meter app called Soundmeter iOS was used to monitor and maintain the habilitationist's voice levels at 60 dB as the habilitationist spoke the content of the test material to the child. According to the test procedure, the habilitationist sat a distance of one meter away from the child and spoke the sentences that instruct the motor tasks to be performed by the child. The habilitationist asked the child to wait until the habilitationist completed the sentence and then to respond by pointing at or picking up a toy. The toy the child selected was placed back onto the table in the same configuration in which the toys were arranged at the start of the test. This ensured that the probability of the child's reactions remained the same.

Each child was tested only once. The test duration was 10–15 minutes. Testing began at level 1 (subtests 1–3) and continued to level 2 (subtests 1–6) unless a score of 0 was obtained. Testing was stopped if a score of 0 was obtained. The children were rewarded with candy or stationery at the end of the test.

Statistical methods

The Kolmogorov–Smirnov and the Shapiro–Wilk tests were used to verify the distribution of the data. The significance level was set to $P \leq 0.05$. The problem of multiplicity, which results from making multiple comparisons, was resolved by adjusting the P values with the Holm–Bonferroni correction method. IBM SPSS Statistics 24 (IBM, Armonk, New York, US) was used for the analyses.

Common object Token subtests

The children's mean scores with the standard deviation (SD) for the COT total score and subtest scores, stratified into groups according to their age at the time of testing (3 to <4 years; ≥4 to <5 years; ≥5 to <6 years, etc.,), were calculated.

To assess the changes in the degree of difficulty between the subtests, the children's scores were determined for subtest 1 to subtest 3 of level 1 and for subtest 1 to subtest 6 of level 2 by applying the Friedman test. *Post-hoc* pairwise comparisons between the individual subtests within level 1 and within level 2 were performed with the Wilcoxon signed-rank test.

Validation criteria

Item homogeneity was checked by correlating the total score and the subtest scores (Pearson correlation). For the NH group, the internal consistency (Cronbach's alpha) and the split-half reliability (Guttman's split-half coefficient) of the total score were determined.

Effect of age

The Pearson correlation was used to assess the overall relationship between age and the total score.

Results

Group with normal hearing

Common object Token subtests

The children's scores for level 1 gradually and significantly decreased from subtest 1 to subtest 3 (Friedman test: $\chi^2 = 39.895$; df = 2; $n = 100$; $P < 0.001$). The decrease in the scores from one subtest to the next was also significant (Wilcoxon signed-rank test: $z = 3.751$ to $z = 5.042$; all $P < 0.001$). The mean scores (±SD) for each of the subtests, when stratified by age, showed that the scores decreased from one subtest to the next [Table 1]. These results suggest that the subtests were arranged in an order of increasing difficulty for level 1 (i.e. subtest 1 is the easiest; subtest 3 the most difficult).

Similarly, the children's scores for level 2 gradually and significantly decreased from subtest 1 to subtest 6 (Friedman test: $\chi^2 = 147.766$; df = 5; $n = 100$; $P < 0.001$), which indicated that the subtests of level 2 were also arranged in an order of increasing difficulty (i.e. subtest 1 is the easiest; subtests 5 and 6 the most difficult). The decrease in scores was significant between subtests 1 and 2 (Wilcoxon signed-rank test: $z = 3.547$; $P < 0.001$), between subtests 2 and 3 ($z = 2.982$; $P = 0.003$), between subtests 3 and 4 ($z = 2.681$; $P = 0.007$), and between subtests 4 and 5 ($z = 4.620$; $P < 0.001$). The scores on subtests 5 and 6 did not differ significantly ($z = 0.605$; $P = 0.545$). The mean scores (±SD) for each of the subtests, when stratified by age, confirmed that the subtests were also arranged in an order of increasing difficulty for level 2 (i.e. subtest 1 is the easiest; subtests 5 and 6 the most difficult) [Table 2].

Validation criteria

Strong and significant correlations were found between the total score and each subtest score of level 1 (Pearson correlations: $r = 0.878$ to $r = 0.941$; all $P < 0.001$), and between the total score and each subtest of level 2 ($r = 0.476$ to $r = 0.947$; all $P < 0.001$). This indicated high item homogeneity. Acceptable internal reliability and consistency were found for applying the Marathi version to the group of 100 children with NH (level 1: Cronbach's alpha = 0.887 and Guttman's split-half coefficient = 0.880; level 2: Cronbach's alpha = 0.911 and Guttman's split-half coefficient = 0.750).

Effect of age

A significant correlation between age and the total score was found for both levels (Pearson correlation: level 1, $r = 0.412$; $P < 0.001$; level 2, $r = 0.361$; $P < 0.001$). This effect of age was also confirmed by the Kruskal Wallis H-test. Within level 1, age had a significant effect on the total score ($P = 0.001$) and on the subtests 2 ($P = 0.020$) and 3 ($P < 0.001$). Within level 2, age also had a significant effect on the total score ($P < 0.001$)

and on subtests 4 ($P = 0.003$), 5 ($P < 0.001$), and 6 ($P = 0.002$). Children under the age of five experienced difficulty after subtest 2 or 3 due to the complexity of the stimuli. On level 2, children aged five and older achieved the maximum possible score for subtest 1. Children aged eight and older achieved the maximum possible score in all subtests, except for subtest 6 [Tables 1 and 2].

Group of cochlear implant recipients

Common object Token subtests

Scores for level 1 gradually and significantly decreased from subtest 1 to subtest 3 (Friedman test: $\chi^2 = 19.811$; df = 2; $n = 16$; $P < 0.001$). The decrease in the scores from one subtest to the next was also significant (Wilcoxon signed-rank test: $z = 2.514$ to $z = 3.360$; $P = 0.001$ to $P = 0.012$). The scores or, if applicable, the mean scores (±SD) for each of the subtests of level 1, stratified by age, confirmed that the subtests for level 1 are arranged in an order of increasing difficulty (i.e. subtest 1 is the easiest; subtest 3 the most difficult) [Table 3].

Figure 1: The collection and sets of toy objects used in the Common Object Token test

Similarly, the children's scores for level 2 gradually and significantly decreased from subtest 1 to subtest 6 (Friedman test: $\chi^2 = 64.490$; df = 5; $n = 16$; $P < 0.001$). The decrease in scores was significant between subtests 1 and 2 (Wilcoxon signed-rank test: $z = 2.988$; $P = 0.003$), and between subtests 3 and 4 ($z = 3.191$; $P = 0.001$). The scores or, if applicable, the mean scores (±SD) for each of the subtests of level 2, stratified by age, showed that the subtests of level 2 were also arranged in an order of increasing difficulty (i.e. subtest 1 is the easiest; subtests 5 and 6 the most difficult) [Table 4].

Validation criteria

Strong and significant correlations were found between the total score and all subtest scores [Tables 5 and 6].

Effect of age

For the children with a CI, age at time of testing did not correlate with the total score for either of the levels (level 1: $r = -0.016$; $P = 0.952$; level 2: $r = -0.156$; $P = 0.563$).

Discussion

CI uptake in India is growing at a considerable rate due to government interest and financial support. Funding is now

Table 1: Level 1 in the group with normal hearing (n=100)

Age groups (at time of testing) (years)	Mean (±SD)			
	S 1	S 2	S 3	Total score on level 1
3-<4 (n=12)	8.83 (±1.89)	8.33 (±1.97)	7.25 (±2.22)	24.42 (±5.69)
≥4-<5 (n=25)	9.40 (±1.0)	8.68 (±1.63)	8.28 (±1.77)	26.36 (±4.05)
≥5-<6 (n=23)	9.35 (±1.23)	9.09 (±1.34)	8.35 (±2.29)	26.78 (±4.43)
≥6-<7 (n=18)	9.83 (±0.51)	9.72 (±0.75)	9.67 (±0.69)	29.22 (±1.80)
≥7-<8 (n=16)	9.94 (±0.25)	9.75 (±0.58)	9.81 (±0.40)	29.50 (±0.89)
≥8-<9 (n=6)	10.00 (±0)	10.0 (±0)	10.00 (±0)	30.00 (±0)

Mean (±SD) of the subtest scores (score range: 0-10) and the mean total score on level 1 (maximum score=30) across different age groups. S 1: Subtest 1, S 2: Subtest 2, S 3: Subtest 3, SD: Standard deviation

Table 2: Level 2 in the group with normal hearing (n=100)

Age groups (at time of testing) (years)	Mean (±SD)						
	S 1	S 2	S 3	S 4	S 5	S 6	Total score on level 2
3-<4 (n=12)	9.83 (±0.577)	9.17 (±1.403)	9.17 (±1.642)	8.67 (±1.775)	7.67 (±2.060)	7.92 (±2.193)	52.42 (±8.847)
≥4-<5 (n=25)	9.92 (±0.277)	9.52 (±1.085)	9.08 (±1.412)	8.88 (±1.563)	8.28 (±1.595)	8.16 (±1.748)	53.84 (±6.823)
≥5-<6 (n=23)	10.00 (±0)	9.35 (±1.301)	9.26 (±1.453)	8.74 (±2.005)	8.17 (±2.348)	8.39 (±2.291)	53.91 (±8.634)
≥6-<7 (n=18)	10.00 (±0)	9.89 (±0.323)	9.89 (±0.323)	9.78 (±0.732)	9.72 (±0.575)	9.67 (±0.594)	58.94 (±2.182)
≥7-<8 (n=16)	10.00 (±0)	10.00 (±0)	9.88 (±0.342)	9.94 (±0.250)	9.63 (±0.806)	9.69 (±0.602)	59.13 (±1.668)
≥8-<9 (n=6)	10.00 (±0)	10.00 (±0)	10.00 (±0)	10.00 (±0)	10.00 (±0)	9.83 (±0.408)	59.83 (±0.408)

Mean (±SD) of the subtest scores (score range: 0-10) and the mean total score on level 2 (maximum score=60) across different age groups. S 1: Subtest 1, S 2: Subtest 2, S 3: Subtest 3, SD: Standard deviation

Table 3: Level 1 in the group of cochlear implant recipients (*n*=16)

Age groups (at time of testing) (years)	Mean (±SD)			
	S 1	S 2	S 3	Total score on level 1
≥3-<4 (*n*=1)	9.0	0	1.0	10.0
≥5-<6 (*n*=4)	7.75 (±3.86)	4.0 (±3.56)	2.0 (±2.31)	13.75 (±9.15)
≥6-<7 (*n*=3)	8.33 (±1.53)	2.67 (±4.62)	0 (±0)	11.0 (±4.58)
≥7-<8 (*n*=2)	10.0 (±0)	7.0 (±4.24)	6.0 (±5.66)	23.0 (±9.89)
≥8-<9 (*n*=1)	6.00	0	0	6.0
≥9-<10 (*n*=1)	9.00	10.0	10.0	29.0
≥10-<11 (*n*=2)	7.50 (±3.54)	2.50 (±2.12)	0.50 (±0.71)	10.50 (±6.36)
≥11-<12 (*n*=1)	10.00	3.0	0	13.0
≥12-<13 (*n*=1)	10.00	0	0	10.0

Mean (±SD) of the subtest scores (score range: 0-10) and the mean total score on level 1 (maximum score=30) across different age groups. S 1: Subtest 1, S 2: Subtest 2, S 3: Subtest 3, SD: Standard deviation

Table 4: Level 2 in the group of cochlear implant recipients (*n*=16)

Age groups (at time of testing) (years)	Mean (±SD)						
	S 1	S 2	S 3	S 4	S 5	S 6	Total score on level 2
≥3-<4 (*n*=1)	10.00	8.00	10.00	0.00	1.00	1.00	30.00
≥5-<6 (*n*=4)	9.75 (±0.50)	6.00 (±4.00)	6.50 (±4.43)	3.00 (±3.45)	0.25 (±0.50)	1.50 (±1.73)	27.25 (±12.55)
≥6-<7 (*n*=3)	9.33 (±1.15)	8.00 (±1.73)	4.67 (±3.79)	1.00 (±1.73)	2.00 (±3.46)	0.33 (±0.58)	25.33 (±11.85)
≥7-<8 (*n*=2)	10.00 (±0)	10.00 (±0)	8.50 (±2.12)	6.00 (±5.66)	5.00 (±7.07)	5.50 (±4.95)	45.00 (±19.80)
≥8-<9 (*n*=1)	10.00	8.00	6.00	0.00	0.00	0.00	24.00
≥9-<10 (*n*=1)	10.00	5.00	5.00	0.00	0.00	0.00	20.00
≥10-<11 (*n*=2)	10.00 (±0)	7.50 (±3.54)	7.50 (±3.54)	2.00 (±0)	0.00 (±0)	1.00 (±1.41)	28.00 (±8.48)
≥11-<12 (*n*=1)	10.00	8.00	10.00	0.00	0.00	0.00	28.00
≥12-<13 (*n*=1)	10.00	10.00	0.00	0.00	0.00	0.00	20.00

Mean (±SD) of the subtest scores (score range: 0-10) and the mean total score on level 2 (maximum score=60) across different age groups. S 1: Subtest 1, S 2: Subtest 2, S 3: Subtest 3, SD: Standard deviation

Figure 2: Circles used to test for color blindness

more readily available across India and is being allocated to CI candidates in need of financial support. Age at implantation is decreasing across India. As a consequence, professionals in various branches of hearing rehabilitation are in need of outcome measures and assessment tools to monitor the results of CI in young children.

Language in India is regionalized state-wise, and English is widely used as a common language. However, not all demographic and socioeconomic groups are sufficiently proficient in English so that hearing rehabilitation can be conducted in English. Therefore, it is expected that test materials should be available in CI recipients' first language to ensure confidence in their test results; it reduces the probability that factors such as a limited vocabulary in the language of the test material affect test scores. Monitoring tools that are available in pediatric CI recipients' first language facilitate their language development and improve developmental assessments. Rehabilitationists should be equipped with appropriate information and adequate resources to maximize the possibility of favorable outcomes in terms of language development in very young CI recipients.

In the western state of Maharashtra, the COT test was chosen to monitor speech and sentence perception in pediatric CI recipients. The test material was translated and adapted to the Marathi language following the recommended guidelines of the ITC.[8] The translation and adaptation procedures for developing appropriate pediatric speech perception tests in languages other than English are well documented in the literature.[5,6] The finalized Marathi version was administered to and validated on Marathi-speaking children who have NH. Analyses of the test scores confirmed that the mean subtest scores, when stratified by age, decreased on both

Table 5: Level 1 in the group of cochlear implant recipients (n=16)

Total score on level 1	S 1	S 2	S 3
r	0.623	0.933	0.900
P (two-sided)	0.010*	<0.001*	<0.001*

Pearson correlation coefficients, *r*, between the mean total score and each of the 3 mean subtest scores. *Significant correlation. S 1: Subtest 1, S 2: Subtest 2, S 3: Subtest

Table 6: Level 2 in the group of cochlear implant recipients (n=16)

Total score on level 2	S 1	S 2	S 3	S 4	S 5	S 6
r	0.428	0.673	0.754	0.840	0.776	0.871
P (two-sided)	0.098	0.004*	0.001*	<0.001*	<0.001*	<0.001*

Pearson correlation coefficients, *r*, between the mean total score and each of the 6 mean subtest scores. *Significant correlation. S 1: Subtest 1, S 2: Subtest 2, S 3: Subtest 3

levels [Tables 1 and 2]. This decrease in mean scores from one subtest to the next is indicative of the increasing complexity of the motor tasks of the test. In addition, the older the age group, the better the mean of the total score for each level; older normal-hearing children performed better than younger normal-hearing children on the increasingly challenging tasks on level 1 and on level 2.

These results are in agreement with the age-related trends observed when normal-hearing children, with English as a first language, are tested with the original English version. It can thus be concluded that the finalized Marathi version is a valid test for monitoring and systematically assessing age-related speech perception and identification skills in children with NH, for whom Marathi is a first language.

Whether the finalized Marathi version is also suitable for children with hearing impairment was assessed by testing 16 pediatric CI recipients for whom Marathi is a first language. Tables 3 and 4 show that despite the small sample sizes of the age groups, results were still comparable to those of their normal-hearing peers. The subtest scores decreased from one subtest to the next as the tasks became more challenging. Thus, the finalized Marathi version seems to be an acceptable addition to the standard auditory test battery used in the western state of Maharashtra. The test should be implemented at clinics and hospitals throughout the state in the near future.

This is a preliminary study that does have some limitations. Sixteen CI recipients is a relatively small study population, but the results agreed with those seen in the much larger group of children with NH, except in terms of chronological age. A statistically significant relationship between the children's performance on the Marathi version and age was not found, which may be due to the small sample size of CI recipients in this study. In future studies, more data should be collected from a much larger study population of CI recipients with a large enough sample size to produce accurate results.

Having said that, the results presented in this paper were comparable to those of a previous validation study by Jeyaraman *et al*. (2016), where the COT test was adapted to Sinhalese. The results agreed with those of Jeyaraman *et al*. (2016).[6] Notably, the Marathi version is characterized by high internal reliability and consistency just like the Sinhalese version.

As recommended by Jeyaraman *et al*. (2016), whether the COT test is suitable to any individual pediatric CI recipient should first be assessed by the test administrator; the basic skills of the child, e.g. knowledge of the colors and previous exposure to the toy objects featured in the test, will affect their performance on the test. In fact, assessing the child's previous exposure in a pre-testing phase is a very important step in pediatric speech perception test procedures that is not unique to the COT test. It is common to other test setups and procedures and its importance is emphasized in the literature.[5,6] Specific to the COT test, however, is that before the start of formal testing, the test administrator should verify that the child can visually distinguish between the colors, e.g. that the child is not color-blind, that the child can name the colors, and that the child knows the toy objects.[2,6] Familiarization of the test material is, therefore, very important when using the finalized Marathi version of the COT test in clinical settings.

Conclusions

The Marathi version of the COT test is a valid tool for assessing the age-related development of speech perception in Marathi-speaking children with NH and Marathi-speaking children with CIs.

The authors recommend that the Marathi version devised in this study should be implemented in hospitals and CI centers in the state of Maharashtra as a first-language tool for assessment of pediatric speech perception and language production.

This is a preliminary study and there remains scope to investigate a larger study population to further substantiate the authors' recommendation of using this version to assess CI recipients with Marathi as a first language.

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Conflicts of interest

There are no conflicts of interest.

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