The Lexical Neighborhood Test: Telugu Version for Hearing Impaired Children

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INTRODUCTION

- Listening to speech is automatic and seemingly effortless. It is an essential part of our daily communication.
- Hearing is most significant ability to develop and use oral language is closely related to the ability to process speech through the ears.
- People are able to extract linguistic and indexical information from speech because of the specialized way the human hearing mechanism.
- Successful recognition of a spoken word requires the listener to match phonological input to the correct lexical entry in the mental lexicon.
- The crucial role of hearing in spoken language development is demonstrated by the language delays observed among the children with bilateral hearing loss (Dale, 1974; Lach, Ling, & Ling, 1970, Quigley & Paul, 1984).
- Neighborhood Activation Model (NAM; Luce & Pisoni, 1998): process of spoken word recognition proceeds as follows
  - I. Perception of a spoken word activates the item’s lexical entry as well as those of words that are acoustically similar to the spoken word
  - II. The perceived word is selected from the activated lexical neighborhood, while competitors (i.e., neighbors) must be inhibited.
- Hearing impairment is one of the most prevalent disorders in India.
- Hearing loss is permanent and results in significant delay in speech and language development and consequently in important integration problems in the mainstream educational system (Brannon 1966, Davis 1974, Davis 1986, Andrews 1991, Geers 1989).
- Hearing aids were unable to restore hearing sufficiently to prevent these severe consequences of congenital deafness.
A cochlear implant (CI) is a surgically implanted electronic device that functions as an auditory prosthesis for patients with severe to profound sensor neural hearing losses.

Aims / objectives of the study

- To develop a version of the Lexical Neighborhood Test in the Telugu language.
- To investigate the feasibility of the newly developed test and explore the effects of lexical properties on word recognition in Telugu speaking children with normal hearing (NH).
- To develop a reliable speech perception test that can be used to assess children with Hearing Impairment Children.
- To investigate the feasibility of the newly developed test and explore the effects of lexical properties on word recognition in Telugu speaking children with hearing impairment who are using Hearing Aids.
- To investigate the feasibility of the newly developed test and explore the effects of lexical properties on word recognition in Telugu speaking children with hearing impairment who are using Cochlear Implants.
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- To investigate the feasibility of the newly developed test and explore the effects of lexical properties on word recognition in Telugu speaking children with hearing impairment who are using Hearing Aids.
- To investigate the feasibility of the newly developed test and explore the effects of lexical properties on word recognition in Telugu speaking children with hearing impairment who are using Cochlear Implants.

HYPOTHESIS

- Can the predictions of the NAM be generalized to Telugu speaking children!
- Version of the Lexical Neighborhood Test in the Telugu language test Is reliable!
- Version of the Lexical Neighborhood Test in the Telugu language test is applicable to administer in Telugu speaking children and hearing impairment children.
METHODOLOGY

Methodology conducted in the following phases:

- Development of the Telugu lexical neighborhood test.
- Administration of the Telugu lexical neighborhood test on normal hearing children.
- Administration of the Telugu lexical neighborhood test on hearing impaired children with hearing aids.
- Administration of the Telugu lexical neighborhood test on hearing impaired children with cochlear implants.

Development of the Telugu lexical neighborhood test

Participants: 100 children.
Age range: 3 to 5:11 years.

Selection criteria for Normal children:

a) Mother tongue was Telugu language.
b) Used predominantly Telugu language for communication.
c) Performance in the school was average.
d) Attend regular school with Telugu as the medium of education.
e) No history of failure in the recent examinations.
f) Normal motor, cognitive, social-emotional, speech and language development as reported by parents and teachers.
g) Belong to middle socioeconomic status.

h) Procedures: A brief case history recorded from all the children for examination.
i) Materials: Two books with pictures and scenes about daily living activities which the children were asked to talk about. Also, children were given a task of retelling a story from a sequence of pictures, using three short stories that were constructed in a specific way to include lexical neighbors.
j) Equipment: Language sample Recorded by using Roland R09-HR digital recorder.
Results & Discussion:

language samples transcribed both phonetically and orthographically.

- words that were transcribed was 28979.
- The total number of unique words was 4385.
- Monosyllabic – 641.
- Bisyllabic – 2773.
- Multisyllabic classes – 971.
- Dominance of bisyllabic words implied that the development of a monosyllabic or multisyllabic test may not be desirable.

The collection of the language sample was straightforward, but analysis of the sample revealed some difficulties in the use of the lexical Neighbourhood framework. First, most of the words in the samples were conjugated or inflected and the method used here to remove those inflections meant that some of the verb tenses had to be changed to the imperative form to preserve the original pronunciation.

The second part of this research involved the construction of a word recognition test using bisyllabic words in the Telugu Language. Developing this test in a single specific dialect was crucial to avoid inaccurate assessment of speech perception skills caused by dialectal differences among Telugu speakers. An advantage of having a speech perception test that controls for dialects is that all selected words are familiar to children within that geographical area.

Conclusion:

The current study aimed at developing a clinical speech perception test that could be used with Telugu speaking children with hearing impairment. The test was based on the same theory as the English Lexical neighbourhood Test developed by Kirk et al. (1995); the Neighbourhood Activation Model (NAM). Even though there are huge differences between the English and Telugu languages with regards to language structure, it was possible to develop a Telugu Lexical Neighbourhood Test that was consistent with the NAM.
Administration of the Telugu lexical neighborhood test on normal hearing children

Participants: 50 children.

Age range: 3 to 5:11 years.

Selection criteria for Normal children:

a) Telugu as the first or only spoken language

b) Absence of known developmental delays or learning disabilities.

c) Screening for normal hearing was performed with a GSI 61 portable audiometer and normal hearing range children selected for test.

Materials:

a) The lexically-controlled Telugu Lexical Neighbourhood test words were digitally recorded by a female native speaker of Telangana.

b) The easy and hard words were randomly assigned to four lists of 25 items, each containing a combination of easy and hard words.

Instrumentation:

- Pure tone Audiometer- a calibrated two channel audiometer, Elkon-ed 3N3 multi was used to present the stimulus from the laptop.

- Computer – Lenovo ideapad (Y 450) with Adobe Audition Software (Version 1.0).

- Sound Level Meter- Radio Shack Digital sound level meter, type -33-2055.

- Free field speaker –Boss sound speakers.

Test environment: acoustically treated (and electrically shielded) double room set-up.

Test Presentation:

- Stimulus presented at the level of hearing level.

- The participants were instructed to be seated on the chair placed at the prior mentioned position with a small table positioned in front with microphone (digital Recorder) to record the stimulus.
Results and Analysis:

- The equivalency of the TLNT lists was assessed by comparing the mean scores and standard deviations for each list.
- Responses were recorded in the response sheet for each list of words individually.
- Scores of the 50 children on each list of TLNT were assessed and calculated based on number of words perceived correctly.
- To test whether the lexical properties of word frequency and neighbourhood density affect speech perception, children’s scores on the easy word list were compared to their scores on the hard word list.
- the Wilcoxon Signed Ranks test was used.
- List I - Showed that easy words list one scores ($M = 22.72, SD = 0.75$) had a significantly higher score than hard words list one ($M = 17.14, SD = 1.22$, with $p < 0.01$).
- List II - Showed that easy words list two scores ($M = 22.44, SD = 0.78$) had a significantly higher score than hard words list two ($M = 16.78, SD = 1.14$, with $p < 0.01$).

![Mean Score of LNT](image)

**Mean Scores for Normal Hearing Children**

Discussion & Conclusion:

- Results of this experiment revealed that easy words were identified with greater accuracy than hard words implying that the lexical properties of neighbourhood density and word frequency when co-varied do have an effect on word recognition. However, the difference in scores between the two word lists was fairly small.
- These findings extend previous research which has also demonstrated significant lexical effects for lexically-controlled words (i.e., words with high frequency and low density as well as words with the opposite definition) in both NH children (Liu et al., 2011; Wang, Wu, &
Kirk, 2010) and children with cochlear implants (CIs) (Kirk, 1998; Kirk et al., 1995; Yuen et al., 2008) whereby words with sparse neighbourhoods were more easily identified than words with dense neighbourhoods.

- Finally, the TLNT has been shown to be a sensitive measure for evaluating speech perception skills with a high degree of test-retest reliability.

**Administration of the Telugu lexical neighborhood test on hearing impaired children with hearing aids**

**Participants:** 50 children (Hearing Impairment using Hearing Aid).

**Age range:** Average chronological age of the selected participants was 5 Years.

**Selection criteria for Normal children:**

- Congenital Bilateral severe to profound sensorineural hearing loss (SNHL)
- Minimum one year of hearing experience using the hearing aid.
- Consistent use of the Hearing device.
- No cognitive deficits or associated behavioral problems
- No past history of neurological problems.
- No illness on the day of testing.

**Materials:**

a) The lexically-controlled Telugu Lexical Neighbourhood test words were digitally recorded by a female native speaker of Telangana.

b) The easy and hard words were randomly assigned to four lists of 25 items, each containing a combination of easy and hard words.

**Instrumentation:**

- Pure tone Audiometer- a calibrated two channel audiometer, Elkon-eda 3N3 multi was used to present the stimulus from the laptop.
- Computer – Lenovo ideapad (Y 450) with Adobe Audition Software (Version 1.0).
- Sound Level Meter- Radio Shack Digital sound level meter, type -33-2055.
- Free field speaker –Boss sound speakers.
**Test environment:** acoustically treated (and electrically shielded) double room set-up.

**Test Presentation:**

- Stimulus presented at the level of hearing level.
- The participants were instructed to be seated on the chair placed at the prior mentioned position with a small table positioned in front with microphone (digital Recorder) to record the stimulus.

**Results and Analysis:**

- The equivalency of the TLNT lists was assessed by comparing the mean scores and standard deviations for each list.
- Responses were recorded in the response sheet for each list of words individually.
- Scores of the 50 children on each list of TLNT were assessed and calculated based on number of words perceived correctly.
- To test whether the lexical properties of word frequency and neighbourhood density affect speech perception, children’s scores on the easy word list were compared to their scores on the hard word list.
- the Wilcoxon Signed Ranks test was used.
- List I - Showed that easy words list one scores ($M= 13.28, SD= 0.90$) had a significantly higher score than hard words list one ($M= 8.12, SD= 1.11$), with $p <0.01$).
- List II- Showed that easy words list two scores ($M= 15.96, SD= 1.33$) had a significantly higher score than hard words list two ($M= 8.98, SD= 1.34$), with $p <0.01$)

![Graph showing mean scores of LNT lists](image)
Mean Scores for Hearing Impaired Children with Hearing aid Usage

Discussion & Conclusion:

 Results of this experiment revealed that easy words were identified with greater accuracy than hard words implying that the lexical properties of neighbourhood density and word frequency when co-varied do have an effect on word recognition. However the difference in scores between the two word lists was fairly small.

 These children scored higher on easy words rather than hard words implies that the lexical factors of word frequency and neighbourhood density influence word recognition, the finding that children’s performance increased with familiarity of the test words and that familiarity ratings were significantly higher for the easy words than the hard words indicates that lexical factors may not be the sole predictors of difference in performance between easy and hard words.

 Finally, though age at hearing aid usage starts and familiarity were significant predictors of performance on the TLNT, effects of duration of device use, and chronological age were not significantly correlated with scores on the TLNT.

Administration of the Telugu lexical neighborhood test on hearing impaired children with cochlear implants

Participants: 50 children (Hearing Impairment using Cochlear Implant).

Age range: Average chronological age of the selected participants was 5 Years.

Selection criteria for Normal children:

☐ Congenital Bilateral severe to profound sensorineural hearing loss (SNHL)

☐ Minimum Six months of hearing experience using the implanted hearing device

☐ Consistent use of the Cochlear implant

☐ No cognitive deficits or associated behavioral problems

☐ No past history of neurological problems.

☐ No illness on the day of testing.

Materials:

a) The lexically-controlled Telugu Lexical Neighbourhood test words were digitally recorded by a female native speaker of Telangana.
b) The easy and hard words were randomly assigned to four lists of 25 items, each containing a combination of easy and hard words.

**Instrumentation:**

- Pure tone Audiometer- a calibrated two channel audiometer, Elkon-eda 3N3 multi was used to present the stimulus from the laptop.
- Computer – Lenovo ideapad (Y 450) with Adobe Audition Software (Version 1.0).
- Sound Level Meter- Radio Shack Digital sound level meter, type -33-2055.
- Free field speaker –Boss sound speakers.

**Test environment:** acoustically treated (and electrically shielded) double room set-up.

**Test Presentation:**

- Stimulus presented at the level of hearing level.
- The participants were instructed to be seated on the chair placed at the prior mentioned position with a small table positioned in front with microphone (digital Recorder) to record the stimulus.

**Results and Analysis:**

- The equivalency of the TLNT lists was assessed by comparing the mean scores and standard deviations for each list.
- Responses were recorded in the response sheet for each list of words individually.
- Scores of the 50 children on each list of TLNT were assessed and calculated based on number of words perceived correctly.
- To test whether the lexical properties of word frequency and neighbourhood density affect speech perception, children’s scores on the easy word list were compared to their scores on the hard word list.
- the Wilcoxon Signed Ranks test was used.
- List I - Showed that easy words list one scores ($M= 17.97$, $SD= 1.10$) had a significantly higher score than hard words list one ($M= 13.67$, $SD= 1.08$), with $p <0.01$).
- List II- Showed that easy words list two scores ($M= 19.78$, $SD= 1.03$) had a significantly higher score than hard words list two ($M= 13.18$, $SD= 1.35$), with $p <0.01$).
Mean Scores for Hearing Impaired Children with Cochlear Implant Usage

Discussion & Conclusion:

- Results of this experiment revealed that easy words were identified with greater accuracy than hard words implying that the lexical properties of neighbourhood density and word frequency when co-varied do have an effect on word recognition. However the difference in scores between the two word lists was fairly small.

- After applying the TLNT overall results showed that the TLNT is suitable for assessing word recognition in CI children. However, although the fact that these children scored higher on easy words rather than hard words implies that the lexical factors of word frequency and neighbourhood density influence word recognition

Finally, though age at implantation and familiarity were significant predictors of performance on the TLNT, effects of duration of device use, and chronological age were not significantly correlated with scores on the TLNT.

Discussion & Conclusion

- All the data analyzed and identified the results plotted with mean values show that highly significant data occurs with this TLNT.

- Test will be use full to analyze the speech perception abilities in normal hearing children and hearing impairment children.

- This test will be useful widely in the Telugu people.

- Clinical assessments often require that the test be repeated every 6 months at least in order to monitor progress over time.

- Cochlear implantation is much better than hearing aid in the speech perception.
• Mean Scores of TLNT for Normal and Hearing Impaired Children

**Recommendations of the test**

- Test will be useful to analyze the speech perception abilities in normal hearing children and hearing impairment children.
- Test will be useful to analyze speech and hearing communication disorders.
- Test will be useful to analyze progress of the speech therapy or Auditory verbal therapy.

**Limitations of the study**

- Test will be useful to analyze Telugu speaking children only.
- The Telugu speech Perception stimulus lacks standardization, as the sample size was small.
- Test will need to analyze with more samples.

**Future Recommendations**

- This study can be conducted in different languages.
- This study can be conducted in different Dialects.
- This study can be conducted in different School age groups.
- This study can be conducted in different School setups.