

THE WORD IN CONTEXT INTELLIGIBILITY TEST (WICIT)
Robyn M. Cox,^{1,2} Izel M. Taylor,¹ and Ginger A. Gray,²
Department of Veterans Affairs Medical Center¹ and The University of Memphis²
 Presented at the American Academy of Audiology National Convention, Dallas, TX, 1995

Abstract

The WICIT was developed as a clinical test to quantify use of linguistic context by hearing-impaired listeners. We hypothesize that the score will be related to hearing aid benefit. This poster describes the development of the WICIT and provides preliminary data from normal and hearing-impaired listeners. There are four lists, both presented in high-predictability and zero-predictability formats. Scores for the test are consistent with the theoretical predictions by Boothroyd and Nittrouer (1988). However, despite efforts to equalize the four lists, there are some small but significant differences in difficulty among them. Reliability of scores based on half the test (two lists) appears to be reasonable but the practical significance of the observed test-retest differences cannot be evaluated at this time. Future work will assess the relationship between WICIT scores and hearing aid benefit. (Supported by the Department of Veterans Affairs RR&D Service).

Background

The benefit an individual derives from a hearing aid is related to several acoustic and auditory variables including improvement in speech audibility, in-situ distortion, and high-frequency auditory resolution. Nevertheless, even when all of these variables are taken into account, prediction of benefit for a given individual is not very accurate. This outcome suggests that there are non-auditory variables on which individuals differ that are related to the amount of benefit they will receive from a hearing aid. These might include both psychological/personality variables and cognitive variables.

One variable of potential value relates to the ability of the hearing aid wearer to "fill-in" missing information in the perceived acoustic signal. When amplification is used, the audibility of speech cues is typically improved but usually remains less than complete, especially in the noisy listening environments typical of daily life. Thus, full exploitation of improved audibility yielded by a hearing aid might depend to some extent on the wearer's ability to use linguistic context to predict unheard words in partially heard sentences. If this is so, then an individual's ability to capitalize on contextual cues could be a valuable non-auditory predictor of the amount of benefit that he/she can anticipate from a hearing aid fitting.

In order to study the relationship between use of context and hearing aid benefit, it was necessary to generate a clinically applicable method for quantification of context use. Accordingly, we have developed the Word in Context Intelligibility Test (WICIT), based on principles developed by Boothroyd and Nittrouer (J. Acoust. Soc. Amer., 84:101-114, 1988).

What is the WICIT?

The WICIT includes high-predictability (HP) sentences and zero-predictability (ZP) sentences.

HP sentences are context-rich four-word sentences,

e.g., "Feet have five toes".

ZP sentences are meaningless four-word combinations,

e.g., "Red June hay paint".

Use of context is measured by comparing intelligibility scores for HP and ZP sentences.

The score for the test is the individual's k-factor, where:

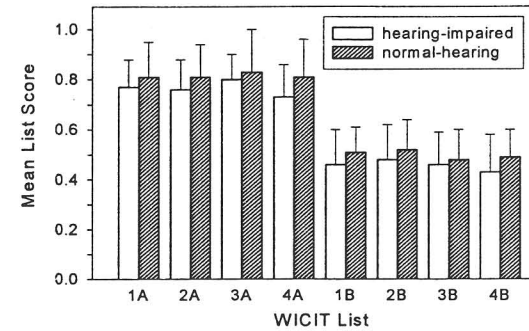
$$k = \log(1-HP)/\log(1-ZP)$$

This score is a dimensionless quantity that is independent (within certain limits) of factors such as hearing loss, competing noise, and listening level.

Test Development

1. The talker was chosen from a pool of eight individuals, based on a tournament to select the one with the most natural, average speech.
2. The initial pool of material consisted of 103 HP sentences (412 words).
3. Each word was digitized with both flat and falling intonation.
4. The digitized words were edited to construct the 103 HP sentences using a flat-flat-flat-falling intonation pattern.
5. The 103 HP sentences were presented to 15 normal hearing listeners at a S/N of 0 dB (competition = speech-shaped noise).
6. Error patterns were scrutinized and the 80 most intelligible sentences were selected for the test.
7. 15 of the rejected HP sentences were retained for practice and learning purposes.
8. Word familiarity scores were determined for each of the 80 test sentences.
9. Intelligibility and word familiarity were combined into a single score for each sentence.
10. The sentences were distributed into four theoretically equivalent lists (lists 1, 2, 3, and 4) of 20 sentences each.
11. The 80 words within each list were then randomized to construct 20 ZP sentences.
12. Thus, each of the four lists has an HP format (list A) and a ZP format (list B).

List Equivalence



- This figure depicts mean scores for normal-hearing and hearing-impaired listeners for HP lists (1A, 2A, 3A, and 4A) and corresponding ZP lists (1B, 2B, 3B, and 4B). Error bars show one standard deviation.
- Although the differences among the mean scores are small, some of them are statistically significant.
- Thus, it will be necessary to re-distribute the sentences to maximize list equivalence.

Score Reliability

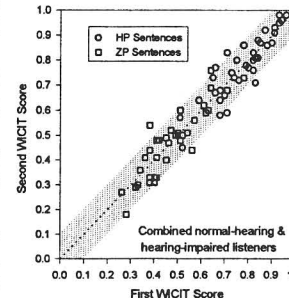
This poster reports data obtained when scores for all four lists of the WICIT were combined.

Administration of the complete test (four lists) consumes about 20 minutes.

How reliable would the scores be if only half of the test (two lists) was used, thus reducing testing time to about 10 minutes?

This figure shows a comparison of two WICIT scores, each based on two test lists (40 sentences).

- Each symbol depicts the combination of first score and second score.
- Perfect agreement would result in the symbols all falling on the diagonal line.
- Scores within the shaded area were within 10 percent of each other.
- Agreement between the two scores, while seldom perfect, was almost always within 10 percent.

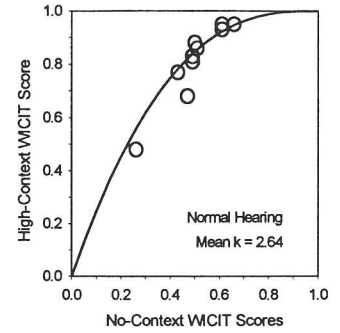


Normative Data

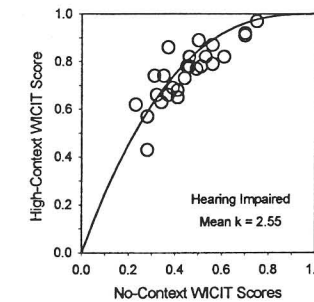
The solid line in the figure at right illustrates the performance of normal-hearing listeners for HP and ZP sentences reported by Boothroyd and Nittrouer (1988).

The circles show performance for 10 normal-hearing subjects on the WICIT.

There is good agreement between the Boothroyd and Nittrouer function and the data from the WICIT.



Hearing-Impaired Listeners

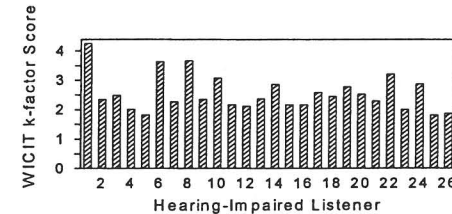


The figure at left shows performance of 26 hearing-impaired listeners compared to the normative function presented by Boothroyd and Nittrouer (1988).

The good overall agreement between the circles and the solid line indicates that these subjects utilize context about as much as the normal-hearing listeners do.

The figure below depicts k scores for the 26 hearing-impaired subjects. There is considerable variability within this group.

For example, subject #5, with a k score of 1.82, uses contextual information considerably less than does #6, with a k score of 3.64.



Future Direction

The next step will be to determine whether differences in k scores are related to differences in benefit derived from amplification. Investigation of this issue is underway.

