**Proceedings of the Institute of Acoustics**

# THE ACOUSTIC ENVIRONMENT IN HIGHER EDUCATION CLASSROOMS. DO OVERSEAS STUDENTS FACE GREATER DIFFICULTIES DISCRIMINATING SPEECH THAN HOME STUDENTS.

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## ABSTRACT

Anecdotal evidence suggests that overseas students are often at a disadvantage when asked to listen in conditions which are acceptable to home students. This paper reports on a short investigation which attempts to quantify any differences in terms of the 50% speech discrimination scores of test material presented in classroom noise.

## INTRODUCTION

The perception of speech is well described by Pisoni et al (1987), Moore (1989) and Handel (1989). In particular the discrimination of speech audiometric tests have been extensively discussed by many authors with thorough overviews being provided by Penrod, (1985) and Martin (1987). There have been numerous studies examining the factors that affect the discrimination of speech in speech discrimination tests, notably Hood and Poole (1980). Of particular interest to this report is the effect that linguistic experience has on speech discrimination in degraded conditions.

Gat and Keith (1978) demonstrated that native speakers of English perform significantly better on word discrimination tests than non-native speakers of English. They suggested that the word lists used, the CIDW-22 list, might have less phonetic redundancy for the non-native speakers of English.

Danhauer et al. (1984) examined three groups of listeners in a test of non-sense English words; native, bilingual and non-native speakers of English. The findings are similar to those of Gat and Keith however the bilingual group did not perform statistically differently to the native speaking group. Other studies have supported these findings (Smith et al. (1987), Keith et al. (1987)).

### Method

The speech material used consisted the AB word lists re-recorded by the RNID. Only the first 10 lists were used for the investigation. The lists

used a male speaker with a Southern British accent and included two practice words at the
start of each list. The tape included a calibration tone of 1KHz lasting for about 1 minute, followed by a passage of continuous speech also lasting for one
minute. Fuller (1987) advises that a 1KHz tone at the start of the lists should be sufficient, providing the tone bears a known relationship to the acoustially
balanced word lists following. In the word lists used the tone represented the mean level of the words, a measurement which could be verified with the continuous speech following the tone.
The second track of the tape was used to record speech babble. The speech babble was prepared by the technical department of the University. It was made by recording six eleven-year-olds (three boys and three girls) reading aloud in an ordinary clasroom using a revox B77 tape recorder. This recording was then amplitude compressed with a 'dbx119' compressor-expander until its intensity did not vary by more than +/- 2dB. There was no need for a specific calibration tone to be made as the babble could be used directly for the calibration purposes.

## Instrumentation

A calibrated Kamplax AC30 2 Channel Audiometer was used to driver 2 Jamo Compact 70 speakers, one speaker from each channel. A Sharp stereo cassette player RT100 was used to provide the input signal, which was then attenuated by the audiometer. The left and right channels were kept separate and routed through separate channels on the audiometer.

Reverberation time ,T, for the room was obtained using a stating pistol as the sound source and a B&K type 2033 High Resolution Signal Analyser. (Appendix B&K HRES). The room had a reverberation time of 0.12 seconds.

Calibration of the test material was made using a recently calibrated B&K Sound Level Meter Type 2203. This was positioned in the position to be occupied by the subjects head. Each channel was individually adjusted using the individual channel attenuators on the audiometer in such a manner that the dB dial reading on the audiometer exactly corresponded to the soundfield measurement of the calibration tones.

The same sound level meter was used to measure the background noise originating from sources other than the test material in the testing room. The level measured was less than 30dBA throughout all the testing.

## Subjects

SPEECH DISCRIMINATION

Subjects were all volunteers taken from the school of Education at the University. All the subjects were postgraduate students studying higher degrees in English Language Teaching or Audiology. The subjects were placed into one of two groups. The first group consisted of native speakers of English. This group was defined as those who had spoken English since birth, and had resided in an English speaking Country. The criteria for the second group was that the subject had spoken English for at least 5 years but that English was not the only language used during that period. All subjects from this last group rated their English as fluent, with the majority, 14 out of 18, having studied English language at an advanced level. All subjects undertook a simple screening headphone test of hearing for pure tones across the frequencies 250Hz to 4KHz at 20 dBHL and volunteers who failed at any frequency in the better ear were not included in the study.

Six subjects from each group were retested within one week of their original test.

Procedure

A pilot study had been carried out so as to determine suitable room arrangements, range of competing noise to signal levels and experimental procedure. During the pilot study various instruction sets were tried until a clear and uncomplicated version was arrived at. Various levels of competing sound were used until a satisfactory range was determined. A second scorer was present in the room to allow a comparison with the tester scoring. The agreement between the two differed by just one phoneme, or 3 percent in ten word lists. It was felt that the additional scorer would not be necessary. A lapel microphone was available, to be attached to the subject so that the tester would be better able to hear the subjects response. This was found cumbersome and unnecessary. Confusions were better clarified by pausing the tape and askiing for clarification. All subjects in the pilot study found the higher levels of speech babble distressing to some degree. The design of the experiment took this into account by keeping the experimental procedure to a minimum of time.

The testing took place in a rectangular sound treated room 5.6metres by 5 metres in size. The subject was seated in the centre of the room, facing two loudspeakers set at head hight two metres in front of the subject. Both speakers were at 0 degrees Azimuth, at such a hight that the cones of the upper speaker and lower speaker were 30cm in horizontal distance, approximately 15cm above and below the horizontal plane of the subjects ears.

SPEECH DISCRIMINATION

The audiometer was placed just to one side and just behind the speakers, so as to give the tester a clear view of the subject.

Subjects were made comfortable before being given the following instructions: "You are going to listen to a recording of a man saying some words. After each word there will be a short interval during which I want you to repeat exactly what you heard. If you only heard part of the word repeat only what you have heard."

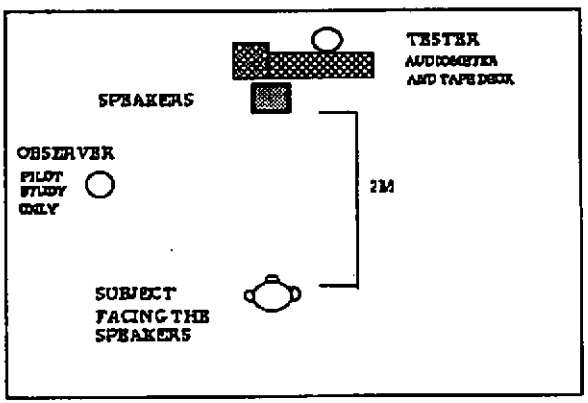
Two lists were then played to the subject in the absence of noise. The tape was then stopped and the subjects were further instructed:

"I am now going to introduced the sound of some people talking. You still have to listen to the words spoken by the man. Sometimes the sound of the people will be very quiet, at other times it will be loud, try to ignore it and listen only to the words and repeat them in a clear voice"

The lists numbers 2 to 10 were presented with varying levels of competing noise. The levels of noise for each test was selected at random by computer to allow two presentations each of +10dB, +5dB, 0dB, and -5dB speech babble relative to the word lists, which remained at a constant level of 65dBA throughout the test.

Scoring was done phonemically, with a broad transcription of incorrect responses made for future reference. The two practice words at the begining of each list were not included in the scoring.

Experimental setup.



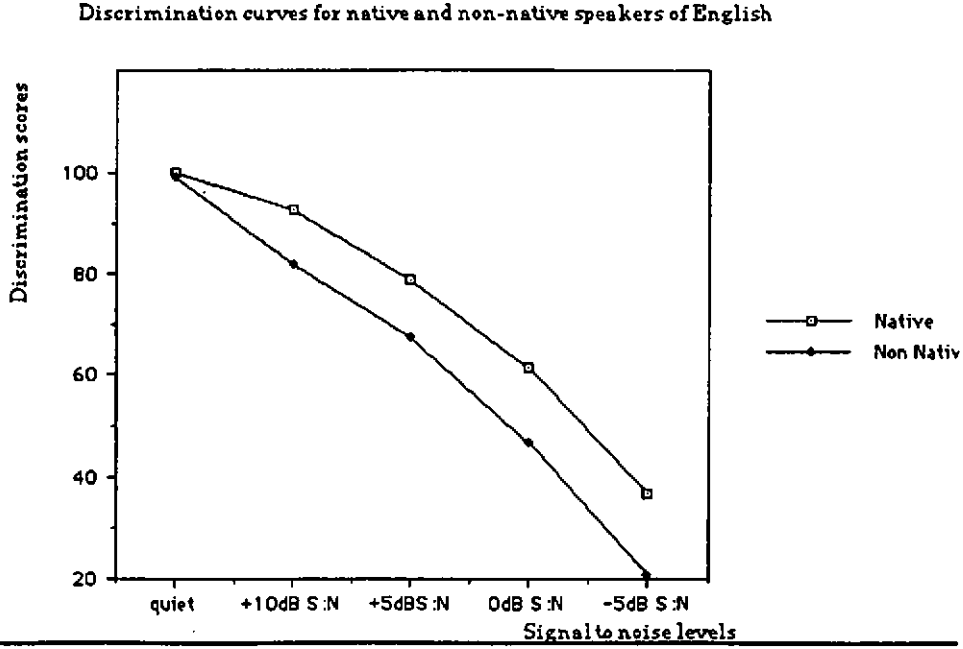
## Analysis

The results were plotted on graphs as Discrimination score against signal to noise ratio. From these the 50 percent discrimination score was determined for each subject.

Comparisons were made within groups and between groups at all levels using paired 't' test within groups and unrelated 't' test between groups. The test/re-test analysis was made using the paired't' test and the correlation coefficient 'r'. The analysis was carried out using SPSS-X Release 3.1 statistical package at the Manchester Computing Centre.

## Results

Results are presented in summary below:




The curves show that in quiet conditions the scores for the two groups are similar but with the introduction of competing noise the scores diverge.

Table of Native speakers of English (A) and Non-Native speakers of English (B) t-test values

| SUB-JECT | N. | MEAN | SD | t VALUE | DF | 2-TAIL PROB |
|---|---|---|---|---|---|---|
| A QUIET | 19 | 100 | .00 | | | |
| | | | | 2.33 | 17 | .035 |
| B. QUIET | 18 | 99.22 | 1.44 | | | |
| A+10 | 19 | 92.74 | 6.47 | | | |
| | | | | 4.11 | 29.83 | <.001* |
| B+10 | 18 | 81.72 | 9.48 | | | |
| A+5 | 19 | 78.52 | 7.50 | | | |
| | | | | 3.85 | 31.37 | <.001* |
| B+5 | 18 | 67.22 | 10.07 | | | |
| A+0 | 19 | 61.58 | 8.98 | | | |
| | | | | 4.53 | 33.54 | <.001* |
| B+0 | 18 | 47 | 10.48 | | | |
| A-5 | 19 | 37.05 | 5.45 | | | |
| | | | | 7.9 | 32.1 | <.001* |
| B-5 | 18 | 20.89 | 7.01 | | | |
| A50%** | 19 | -3.337 | .76 | | | |
| | | | | -9.38 | 22.76 | <.001* |
| B50% | 18 | .89 | 1.78 | | | |

* indicates statistically significant result
** 50% discrimination scores.
A- represents results for native speakers of English
B- represents results for non-native speakers of English

## Discussion

The decrease in discrimination scores with increasing noise levels has been widely published and will not be further commented upon. The difference between the native and non-native speakers of English is also a phenomena widely reported. As such the results support previous studies that show that the use of word lists as a test of speech discrimination also show an influence of the linguistic background of the listener. What is perhaps surprising is the extent of the influence. In the study by Danhauer et al.(1987) the bilingual group showed no statistical difference between the bilingual and native speaking group, this is not supported here. There are several differences. The subjects in the study by Danhauer were all Spanish or English in background. In the present study the subjects came from a wide variety of linguistic backgrounds and it might be supposed that they may have come from phonemically distant backgrounds. However, the subjects rated themselves as having native competence of English. No formal test to

support this was carried out and therefore these represent self ratings only of questionable validity and reliability. It does, however, show that students who rate themselves as having native levels of English may still be at a disadvantage when compared with their native English speaking peers, when listening within the noisy classroom.

Does a statistically significantly different discrimination have a measurable effect on learning? The University of Hertfordshire has a large student population of non-native speakers of English consequently these effects are currently being examined and will be reported in the near future.

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