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English Speech Intelligibility Test among Persons of Arabic Native Language

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English language as a non-native language is the most common language over the world, it is the language of conferences, business and the airports. While the Arabic language is the native language of Egypt, the English language is considered as the second language. This research will conduct to investigate the effect of speech level, rate and repetition on the intelligibility of English language among some highly educated Egyptian persons. Thirty-four males and females subjects are participated in this test. Forty sentences of BKB sentences were used with three scored words per sentence. Firstly; they are subjected to the speech rate of about 220, 190, 160 and 100 words per minute at the speech level of about 60 dBA, which is considered as the normal level. Secondly; they are subjected to the speech level of 60, 70 and 80 dBA at speech rate of 190 words per minute, which is considered as the normal rate. It was found that the intelligibility score increased with decreasing the rate and increasing the level respectively. It was found that scores of the worst scored sentence for the first fifteen subjects did not change, whatever we repeat the tested sentence at normal rate and level.

1 Introduction

The assessment of speech intelligibility plays an important role in a variety of areas such as, e.g., telecommunication, room acoustics, audiology, and evaluation of hearing aids [1]. Efficient communication is one of the keys to providing effective services in number of service-oriented industries such as finance, banking, insurance and tourism [2].

Speech intelligibility is not a physical quantity like Amperes, Volts, or BTU's. It is a measure of the degree to which we understand spoken language, and as such as a complex phenomenon affected by many variables. Speech intelligibility is depending on some conditions related the subject, like the age (young or old), the sex (male or female), the healthy (normal or impaired–hearing) and the language (native or non-native language). Also there are some factors affect the speech intelligibility scores, such as the speech rate and the speech level, many researches studied the effect of these factors, e.g.; Alan H. S. Chan and Phoebe S. K. Lee [2] investigated the relationship between the rate of natural speech and intelligibility for the Chinese speaking. They found that the speech at normal and slow rates was perceived more accurately than speech at fast rates. Also, Sommers [3] studied the effects of speaking rate and speaking level that influenced word recognition with natural speech, and reported that the effect of speaking rate at slow and medium rates had higher identification scores than that of fast rate, and the scores of high and medium level words are higher than that of low level. In this research, we studied the effect of speech level, speech rate and speech repetition on the intelligibility of English language among normal males and females of Arabic native language.

Speech intelligibility is a statistical estimate, the accuracy of the intelligibility value is a function of the number of test items per measurement [4], and it can be evaluated by using a sentence test or single word test. The understanding of a whole sentence appears to be more representative for a realistic communication situation than the intelligibility of a single word or phoneme. Moreover the discrimination functions (i.e. the intelligibility as a function of speech level) are steeper for sentence materials than for shorter speech segments and thus provide a very accurate measurement of a speech reception threshold (SRT) i.e. the speech level that corresponds to 50% intelligibility [1]. In this study, sentence tests are preferred, because several words are tested within each sentence within a short time frame.

Most sentence test can be divided into two different groups by type of sentence material [4]. First, high predictable every day sentences as the German Göttingen sentence test [1], and the American HINT test [5]. The advantage of this test is that there is no training effect when using the test lists only once. The disadvantage, however, is that the test lists usually cannot be used twice with the same subject. Because the meaningful sentences can easily be memorized or words can be guessed from the context. This would generate an incorrect low SRT result. A repeated measurement with the same test list is not possible until a sufficient period of time has passed [i.e. half a year or even longer]. In order to overcome these problems, unpredictable sentence tests were developed. These tests consist of syntactically fixed, but semantically unpredictable nonsense sentences, i.e., sentences with fixed grammatical structure but using words that do not necessarily make sense in their respective combinations. Hagerman first developed this test for Swedish [6] and Wagener et al [7], further adapted this format to German Oldenburg sentence test and Danish DANTALE II [8].

2 Method

A lab-top HP computer of processor 1.5GHz with sound card of type soundmax integrated digital audio connected with highly accurate loudspeaker of Madsen Electronic type are used for stimulus the presentation. An easy speech program of British idioms is used to read the listed sentences. The rate of speech was determined using this program while the speech level was determined using sound analyzer of B&K type.

Thirty-four subjects are participated in this test; they are 18 females and 16 males, age 19-41 years with median age of 24.81 years, they are born and living in Cairo-Egypt. All of them are highly scientific educated, they have studied the English language for 8 years at least in the different principle education stages and the English was the language of education in all university stages. They have no otological problems, and they are normal-hearing with hearing thresholds did not exceed 20 dB HL at 0.5, 1, 2 and 4 kHz, which measured using the clinical audiometer of Madsen Orbiter 922 type.

Before the experiments began, the subjects were informed of the aim of the test. A few practice sentences were given to the subjects to familiarize them with the experimental procedures. A rest break of about 2 min was given after each list of sentences.

3 Stimuli

The sentences for this study were derived from the slightly modification version of the sentence lists included in the revised Bamford-Kowel-Bwnch Standard Sentence Test [9]. They are 40 simple and predictable English sentences, arranged in 4 lists of 10 sentences per list, with three keywords i.e. 120 words were selected for score the speech intelligibility. These sentences were chosen because they include words that are highly familiar to non-natives and are syntactically simple, and in order to overcome the disadvantages, which arise from the simplicity of these sentences we have rearranged the sentences in different and randomly locations in each list for each test. The used sentences in this study are the following;

List 1

1) The children dropped the bag
2) The floor looked clean.
3) The fruit is on the ground.
4) They washed in cold water.
5) The young people are dancing.
6) Father forgot the bread.
7) The girl has a picture book.
8) The orange was very sweet.
9) They had two empty bottles.
10) He is holding his nose.

List 2

1) The boy forgot his book.
2) A friend came for lunch.
3) The ball broke the window.
4) They are shopping for cheese.
5) The pond water is dirty.
6) They heard a funny noise.
7) The police are clearing the road.
8) She writes to her brother.
9) The three girls are listening.
10) The coat is on a chair.

List 3

1) The book tells a story.
2) The young boy left home.
3) They are climbing the tree.
4) The table has three legs.
5) The five men are working.
6) They went on a vacation.
7) The dinner plate is hot.
8) The train is moving fast.
9) The child drank some milk.
10) The car hit a wall.

List 4

1) She looked in her mirror.
2) The good boy is helping.
3) The kitchen clock was wrong.
4) The dog jumped on the chair.
5) Someone is crossing the road.
6) They are riding their bicycles.
7) He broke his leg.
8) The ground was very hard.
9) The buckets hold water.
10) The chicken laid some eggs.

4 Data Analysis

The perception sentences scores were determined by keyword-correct words for each sentence recognized by the subject. This score was obtained by counting the number of keyword transcribed perfectly. And the average percent correct scores for each sentence were calculated from the number of words repeated correctly**.**

5 Results

5.1 Speech rate

Fig.1a shows the average speech intelligibility score (percentage) of the participated subjects at speech rates of 220, 190, 160 and 100 words per minute (w/m) at normal speech level of 60 dBA. As expected, the speech intelligibility score at slow rates is more than that of higher rates i.e. the speech intelligibility increases when the speech rate decreases. From this figure, we can notice easily that at rate of 190 w/m and slower, the speech intelligibility is higher than 50% of scores.

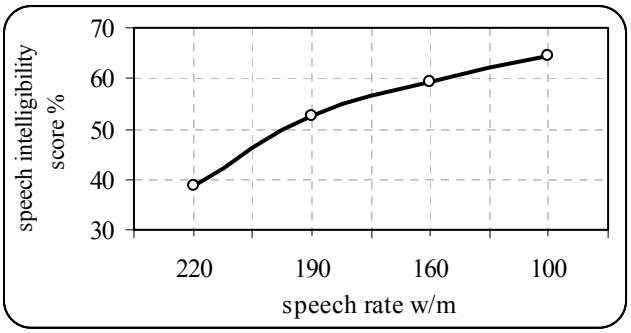

Fig.1a Average speech intelligibility score (percentage) at different speech rates, at normal speech level of 60 dBA.

Fig.1b shows the curves of speech intelligibility scores of the subjects. It indicates that, more than half of the participated subjects had speech intelligibility scores above 50% for all speech rates at the normal level of speech. This figure shows that, approximately, all the curves of intelligibility score have the same behavior, i.e. all of them increase in scores with decreasing in rates, although the great difference between the higher and lower scores.

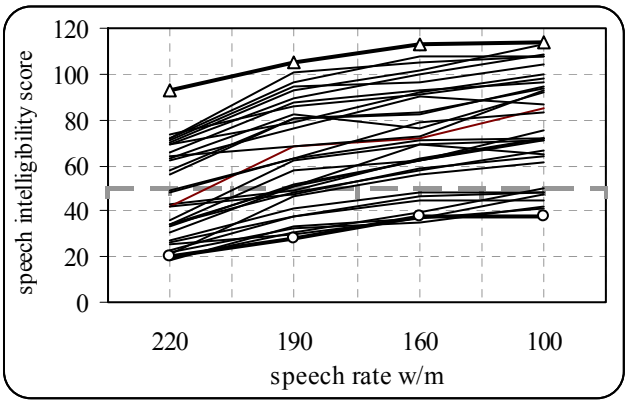

Fig.1b Speech intelligibility scores at different speech rates, at normal speech level of 60 dBA.

5.2 Speech level

Fig.2a shows the average speech intelligibility score (percentage) of the participated subjects at speech levels of 60,70 and 80 dBA at normal speech rate of 190 w/m. as expected, the speech intelligibility score at high levels is more than that at low levels i.e., it is increasing with increasing the level of speech. The figure indicates that the intelligibility scores are more than 50% at all speech levels.

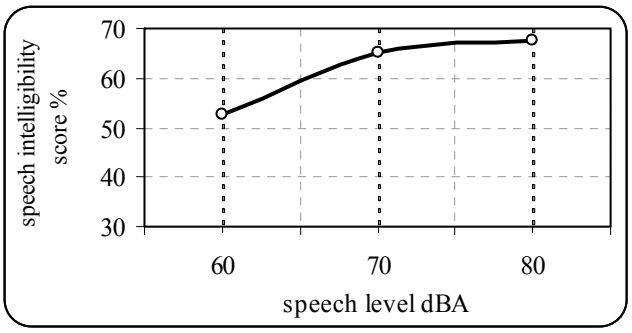

Fig.2a Average speech intelligibility score (percentage) at different speech levels, at normal speech rate of 190 w/m.

Fig.2b shows the curves of speech intelligibility scores of the subjects. It indicates that, more than two-third of the participated subjects had speech intelligibility scores above 50% for all speech levels at the normal rate of speech. Also, the curves in this figure have the same behavior of intelligibility scores.

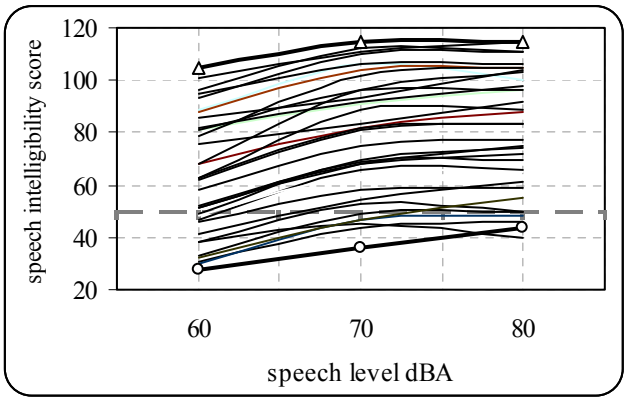

Fig.2b Speech intelligibility scores at different speech levels, at normal speech rate of 190 w/m.

5.3 Speech repetition

In this test, the worst sentence of the participated subject had chosen to be repeated at normal speech rate and level, to know the effect of the speech repetition on the speech intelligibility. The experiments indicated that, the speech intelligibility scores for the first fifteen subjects did not change, whatever we repeat the tested sentence.

6 Conclusion

The results of the present tests support the following conclusions:

- The English speech intelligibility of the highly educated Arabic males and females, increases with decreasing the rate of this speech.
- The English speech intelligibility of the highly educated Arabic males and females, increases with increasing the level of this speech.
- The repetition of non-intelligible sentence does not change in the speech intelligibility.

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