

Effect of Articulation on Auditory Fatigue*

SREEMATHI

Many studies have been reported regarding the influence of the acoustic reflex on TTS. The relation between TTS and acoustic reflex exists because when reflex occurs there will be an attenuation of low frequency sounds reaching the cochlea. TTS is related to the intensity of the signal reaching the cochlea. The reduction in the intensity of the signal brought about by reflex action can be expected to result in less TTS.

The action of middle ear muscles has been used to explain the results of various studies on TTS (Morita, 1958 ; Fletcher *et al.*, 1960 ; Ward, 1962 ; and others).

Studies of Karlovich and Luterman (1969), Luterman and Karlovich (1969), Binquerel and Bay showed less TTS during articulation than without articulation at low frequencies. Karlovich and Luterman (1969) explained this reduction in TTS on the basis of middle ear muscle action.

According to Ward (1973) acoustic reflex hypothesis is restricted to low frequencies.

The present study was an attempt to investigate whether there is any significant difference in TTS between control condition and experimental condition to high and

low exposure frequencies at equal intensity level and for equal duration of time.

Also the study was designed to find whether factors like sex difference, ear difference and exposure frequency affect the results significantly or not.

Madsen portable audiometer calibrated to ISO (1964) specifications was used in this study. TTS for control condition and experimental condition was measured in 10 males and 10 females of normal hearing subjects. Male group was divided into 2 sub-groups G_3 and G_4 . Female group was divided into 2 sub groups G_1 and G_2 . G_1 and G_2 groups received fatiguing stimulus of 500 Hz tone and TTS was measured at 1000 Hz. G_3 and G_4 groups received fatiguing stimulus of 2000 Hz tone and TTS was measured at 4000 Hz.

A pilot study was done to standardise the test procedure and to establish the intensity level for reading a passage.

The test procedure consisted of 4 conditions :

Control condition : The ear was exposed to a fatiguing stimulus at 120 dB SPL for 10 minutes and TTS was measured immediately after the cessation of the fatiguing stimulus after 1 minute, 2 minutes, 3 minutes, 4 minutes and 5 minutes of recovery.

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Experimental condition: Subjects read an English passage at intensity 70–80 db SPL while his or her ear was exposed to a fatiguing stimulus at 120 dB SPL for 10 minutes continuously and TTS was measured immediately after the cessation of the stimulus after 1 minute, 2 minutes, 3 minutes, 4 minutes and 5 minutes of recovery.

Control and experimental conditions were repeated in the other ear.

Retesting was done for 8 subjects; 2 subjects from each group were selected randomly.

The data collected was then analyzed using appropriate statistical method. Graphical representation was also given due consideration.

Conclusions

1. The results strongly imply that less energy was delivered to the cochlea by the 500 Hz fatiguing stimulus during experimental condition than during control condition. Middle ear muscle action is responsible for the TTS reduction for the experimental condition. This is clear by the fact that there was no difference in TTS for fatiguing frequency of 2000 Hz between control and experimental condition, as the middle ear muscle activity is restricted to low frequencies only.
2. There is no significant difference in TTS between the left ear and right ear for control condition as well as experimental condition.

3. There is no significant difference in TTS between males and females for control condition as well as in experimental condition.
4. On the whole the analysis of the data reveals that subjects who received 500 Hz fatiguing frequency showed significant reduction in TTS for experimental condition.

Implication of the Study

1. The findings throw light on the manner in which the structure and function of component of the auditory system act to influence the transmission of energy delivered to the cochlea particularly the significance of the middle ear muscle and the role they play in altering sound transmission during speech production.
2. A TTS paradigm incorporating speech production activities may be an indirect, but useful procedure for assessing the sound transmission properties of the human auditory system, particularly for higher frequencies (Karlovich and Luterman, 1969).
3. The results of the present study will provide additional information and verification of some of the assumptions existing in the literature on auditory fatigue during articulation.

Limitations

1. The fatiguing frequencies used were limited to only 2 frequencies, *i.e.*, 500 Hz and 2000 Hz.

2. The study was conducted on a small sample of subjects.

Recommendations

1. It may be worthwhile to study the effect of articulation on auditory fatigue using large No. of subjects.
2. It may be worthwhile to study TTS in individuals with confirmed paralysis of the stapedius muscle.

3. Studies pertaining to TTS at different exposure frequencies can be undertaken to verify the results obtained in the present study.

4. As the present study contradicts the earlier reported studies (Weiler *et al.*, 1974) regarding the effects of ear difference further studies are required in this area of research.