Ultrasound influence on impression evaluation of music and Non-linear physiological function of the acoustic peripheral system.

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This paper is the thing that verifies and will examine the thing of the effect of ultrasonic wave on the human concerning two of psychology physics experiment and physiology experiment which mainly made the student to be an examinee.

This study is correspondent to the learning on ultrasonic wave, and it is consistent of three fields. It is three of acoustical engineering, acousticopsychology and sound physiology. Each details is described as a background in the following. The fact is to clarify "that the human auditory model is nonlinear", if it is concretely said ultrasonic wave human. It is proven through the two experiments which did this above mention. It can say, even if to carry out this proof concerning two is one of the novelties of the research.

First, the acoustical engineering in this study is explained. In development and design of the equipment which reproduces contained sound to the ultrasonic wave component, this is not completely related in research itself.

The second is acousticopsychology. The sound which can be caught in the human ear

though there is an individual difference, it has be made with 20Hz～20kHz range as a frequency domain. This is called the audible region. As a frequency band which did not hurt tone color of the sound, W.B.Snow was defined as 40Hz～14kHz. Then H. F.Olson defined the upper limit of frequency band as 15kHz. High frequency component (the ultrasonic wave component) which exceeded the human audible region is not reproduced the upper limit of the frequency recorded in CD which spreads in the world general at present. It has been decided based on "sampling theorem of the Shannon" at 22.05kHz. Generally, over 20kHz is considered an ultrasonic wave, and there is supposed to be no meaning as "it is not audible for the human" sound. By the way, the sampling number of CD is 44.1kHz of the double of the best frequency by the sampling theorem of the Shannon. The quantization number is 16bit, if it is shown by the binary number. There is include-ingly no ultrasonic wave component over 22.05kHz in the music of CD which this reproduced by the Shannon system. However, there are some asking people by still liking music in the music lover of the record. For the analog record, the part of not hearing ultrasonic wave is included for the ear of we humans. There is some an opinion that the reproduced sound of CD is not natural tone quality, when it was compared with the analog record player. The ultrasonic wave component is included for not only sound of the record but also daily natural sound. This shows the details in the introduction.

The third is the sound physiology. The physiology experiment is carried out carry out-ingly with the psychology physics experiment. In the experiment, what kind of effect the difference tone (the sugar beet sound) of ultrasonic wave gives for the human perception, shall be clarified by brain wave measurement and magnetoencephalogram measurement. Physiology experiment of the above has the purpose as the result which the result of the psychology physics experiment is more the robustness. Two experiments are briefly explained again.

In the psychology physics experiment, the difference between the tone quality between CD player with regeneration system for calling the traditional-model Shannon type and ultrasonic wave regeneration system type CD player in which to widely reproduce the ultrasonic wave component is possible is analyzed from the psychophysical standpoint. It is to show "the ultrasonic wave component division influences in the music" fact as a final purpose of the experiment. The examinee is made to listen to music reproduced first of all by the usual method and identical music by the ultrasonic wave regeneration system type CD player by the technique. The impression evaluation experiment (the sound psychology experiment) is carried out for them in the back, and got data is analyzed using the multivariate analysis. By a part of changing music, the equal experiment is carried out again. It is for observing the

difference between the reaction of the examinee. It is recovered that the ultrasonic wave component is analyzed as "CD is a sound source" in the psychology physics experiment as a new control.

It is the fact as a purpose of the physiology experiment "the secondary effect is confirmed by brain wave and magnetoencephalogram in that it occurs on the tympanic membrane in which the secondary effect of the ultrasonic wave component is peripheral and center".In short, the experiment here goes to the center (the auditory sense area) from the periphery (on the tympanic membrane) of auditory sense, and it confirms nonlinear component. And, it contains even in the farther experiment which evidences physiology experiment itself and psychology physics experiment of the above. It is started by measuring to begin with, the auditory sense, when the technique is simply summarized, and sugar beet detection on the tympanic membrane is carried out. And, it was also done that the effect of the ultrasonic wave in the center was confirmed in brain wave (EEG) total and magnetoencephalogram (MEG) total. Here, it is recovered that it detects "the sugar beet sound" which is a difference tone of ultrasonic wave and carries out the brain wave measurement as a new control.

Two experiments on the above shall be together carried out in the multiperson. Psychology physics experiment two kinds. The examinee number is the 18 persons. Examinee number of the experiment of 2 is the 35 persons. The physiology experiment are 36 examinees. The summary is carried out in the element, and the data got from psychology physics experiment and physiology experiment finally is made to be the bind of this paper.

Finally, The fact was proven by psychology physics experiment and physiology experiment "the human auditory model is nonlinear". It was shown that the existence of ultrasonic wave could not disregard in acoustic technique and sound science in this paper.