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A Case of Pure Word-Deafness

(about the relation between auditory perception and recognition of speech-sound)

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The definition of pure word-deafness is postulated as disturbance in auditory perception, which, independently of disorder of hearing, is confined to the sound of speech. According to Lichtheim's conception, the patient can hear the sound of spoken voice but does not recognize them as words. However, the selective deafness for sound of speech without semantic defect is clinically very rare.

On the other hand, the analysis of event in time sequence such as auditory recognition seems more difficult than in spatial event such as optic recognition. As a result of this, the analysis of auditory perception in word-deafness does not yet sufficient, though there have been studied by Stockert and by Richter, etc, while many studies of the relation between perception and gnosia about optic or tactile recognition have been made since Bay and Weizsäcker's work concerning phenomenon of "Funktionswandel".

This report is concerned with a case which is corresponded to the definition of pure word-deafness and was experimentally investigated about the clinical feature of auditory speech recognition.

Case: aged 18, right handed female, factory worker, lower secondary school graduate.

No findings in life history and in hereditary history.

Early in March, 1961, suddenly she lost the comprehension of what was told to her. Though her mother visited some hospitals with the patient, her difficulty in speech comprehension did not decline.

On May 17th, 1962, the patient was admitted to our clinic.

The metal symptoms: she complained sometimes of heavy feeling in the head and of drumming in the ear. Moreover she seemed to feel difficulty on auditory recognition, which was suggested by her statement that she could not understand what was told to her. But it seemed that her awareness of the disease was very superficial because she did not assume the attitude of being troubled with her difficulty.

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The results of psychological test are as follows:

Performance I.Q. 98 on the Wechsler Intelligence Scale.

I.Q. 121 on the Kohs test

According to these results, the disturbance of intelligence was not detected.

In Rorschach test, the factor of psychological conflict was not recogneized in the patient.

Physical examination: there were no findings on neurological examination. Electroencephalogram revealed irregular traces in all leads. In arteriography the reinforcement of shadow of A. temporales posterior was recogneized. Based on the findings of electroencephalagram and arteriogram the existence of organic lesion was supposed though clear localisation was not determined.

Speech-symptoms: the disturbance of speech comprehension was the most predominate feature of clinical symptoms. She was always perplexed what to do, when a simple order was given her in the same manner of speaking as if talking with a normal person. Therefore she could not understand a simple order or question, for instance "What is your job?" "Point your right ear with your left hand" "Take the chair and put it into a corner", before we repeated the same order or question very slowly two or three times. But comprehension was more improved after repetition of the same questions, for instance, "About weather", while comprehension worse suddenly when topics of questions were transmitted from one affair to the other.

Besides, the comprehension of talking with the examiner was better than that of speaking between others.

The repetition of a single sound and of word was also disturbed. Some of records about wrong answers were as follows:

a single sound: hi→ki
fu→mo
na→ma

words: kagi (key)→kami
kane (money)→kagi
kokuban (blackboard)→okuba
fukuya (tailor)→no answer

She could not distinguish clearly words of similar sounds. The repetition of meaningless words was more disturbed than of meaningful words. The repetition of numerals was less disturbed in comparison with repetition of words. There or four numerals were often repeated correctly.

The disturbance of the repetition or a sentence was more severe, and frequencies of "no answer" were much increased.

On the other hand, the disturbance of spontaneous speech was not recogneized though the patient was reticent. Word-amnesia and paraphasia in naming were also not recogneized. Moreover apprehension of meaning of word and of sentense

was preserved when the patient could correctly repeat the orders of the examiner.

With respect to written words there was no disturbance except for that of dictation due to disturbance of speech comprehension.

On the basis of the above-mentioned results, the disability of speech in the patient was confined to the disturbance of recognition about the sound of speech without any semantic defect in which the symbols of words and linguistic symptom lose their specific meaning.

Auditory recognition: the patient could differentiate the qualities of noise such as cry of animals, rattling of a bunch of keys and rustling of paper which were made behind her. Also she could understand the qualities of two kinds of noise being made at the same time. According to our impression the patient seemed rather sensitive to noises.

As for the sense of rhythm, the patient could repeat Morse code which was tapped with a pensil or finger-tip on the table.

The recognition of simple tunes was not so much disturbed. She could name the song when popular children's songs were played on the gramophone. And she could comprehend well which qualities of tunes were, sorrowful or pleasant. However the identification of complicated musical tunes such as some Russian folk songs seemed difficult to her. We could not get her clear answer about the names of such songs. Still more it was unclear whether and how her musical expression was disturbed. She rejected to sing, when we asked her to sing whatever song she liked.

Audiometric testing: (Puretone) audiometric testing was carried out five times. The loss of 10–30 db. for interrupted tone was recognized as shown in Figure 1. The result was always constant throughout each testing. The result of noise-audiometric testing was under normal sphere. The recognition for direction or

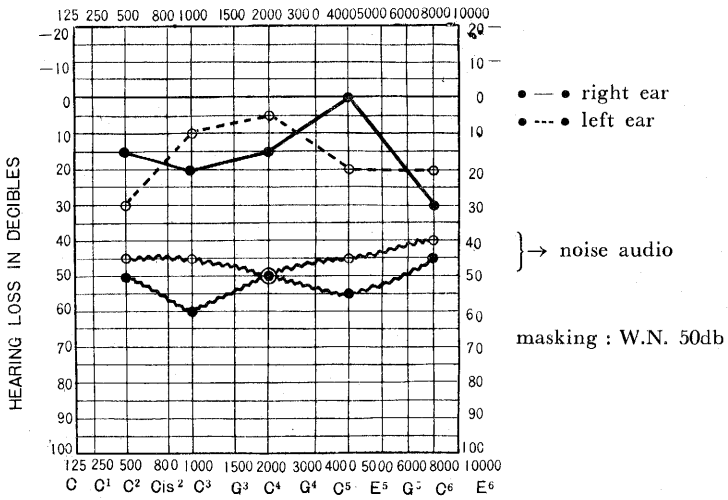


Fig. 1

location of sound was not disturbed.

By speech-audiometry, speech reception threshold for numerals (S.R.T.) and for one syllable speech-sounds was examined. The articulation score in each intensity and S.R.T. were as follows:

Right ear: 10% in 60 db. 8%, 50 and 70 db. S.R.T.=22 db.

Left ear: 14%, in 60 db. 22%, 50 db. 20%, 40 db. S.R.T.=13 db.

Other gnosia and praxia: on visual recognition, either object agnosia or simultanagnosia was not recogneized. The recognition of geometric figure was correct. In Benton's multiple choice test, 13 correct answers were obtained out of 14 question. In Goldstein-Sheerer's sticktest, both imitations and reproductions of models were not disturbed. In Rey's complicated figure, the score in copy was 36 points and the score in reproduction was 28 points. In Bender's test, pascal score was 36 points. In Head's serien tests, good results were obtained except for wrong results by oral command in each test due to the disturbance of speech comprehension.

Tactile agnosia was not recogneized. Also, no abnormality in praxia was detected.

Based on the above-mentioned clinical picture, it can be said that the predominant symptom is the disturbance of speech comprehension due to the disorder of recognition of word-sound. Though there existed the defect of hearing, it seems unquestionable that a slight defect was not enough to explain the disturbance of speech comprehension. Therefore we diagnosed this case as pure word-deafness. Further it seemed necessary for us to study the stability of threshold on auditory perception and on word-recognition in order to elucidate the fundamental characteristics of this case.

We investigated the oscillation of threshold in perception of the interrupted-, of the continuous-, and of speech-sounds.

Conserning the interrupted sounds, the patient could answer correctly the number of stimuli when an examiner gave her sounds many times at certain interval at the intensity of 5 db above threshold and asked her to answer how many times stimuli were given. And the patient was able to discriminate the loudness difference from 5 to 10 db. between two sounds given in succession monaurally in each cycle. This result was constant during the testing carried out many times and was under the extent of normal variation. Therefore, the threshold in perception of the interrupted sounds was nearly stable.

On the other hand, with respect to the continuous sound, the stability of threshold was at first examined by automatic audiometry (v. Békésy, G.). Figure 2 shows the result of this test in the patient. The trace of line, as is shown in Figure 2, exhibits the degree of hearing-loss when the patient percepted continuous sounds incessantly changing at a certain intensity. The line trends to oscillate largely. The extent of oscillation is very remarkable.

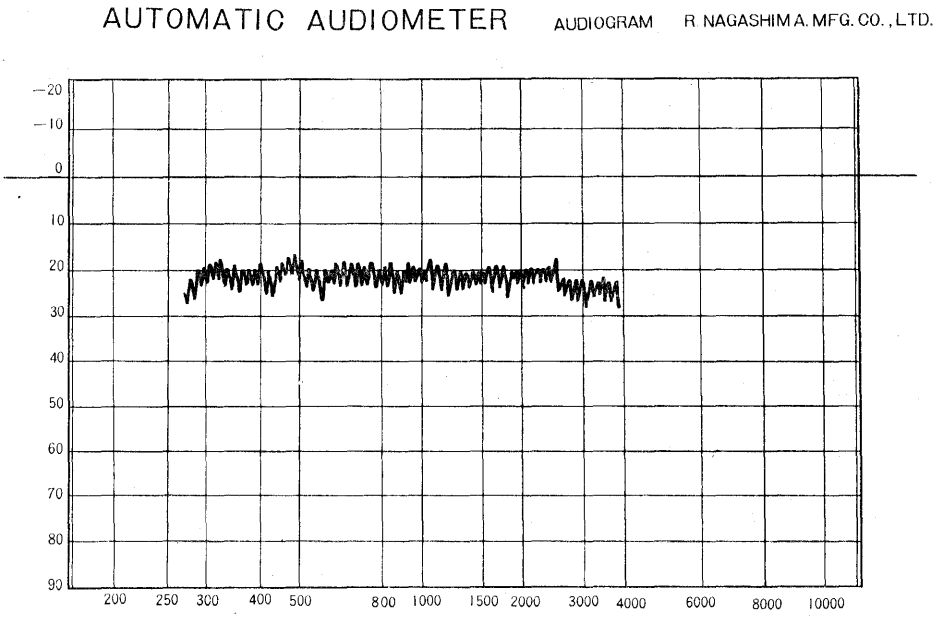


Fig. 2

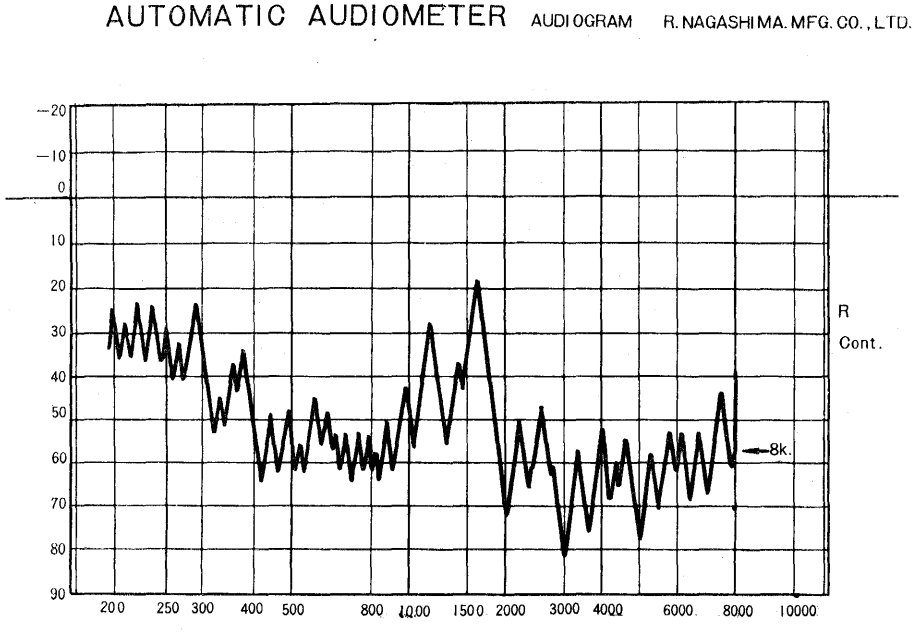


Fig. 3

Figure 3 shows the results of the same testing in a normal adult, in which shaking of line was more constant and smaller than that in Figure 2. The extent of oscillation of line seems to indicate the concrete picture of changeablity of threshold in perception of continuous sound. When compared with the results bet-

ween Figures 2 and 3, it is found that the threshold of auditory perception of continuous sounds in the patient was changeable from time to time.

The results of Lüscher and Zwisloki's test showed also poor value of differential limen for variation of tonal intensity, for instance, in the intensity of 15 db. (above the threshold of the patient) differential limen was 4–3 db. and in the intensity of 60 db. (above the threshold of the patient) 0.8–1.2 db.

Moreover when certain continuous sounds were given during a definite period of time, it was indicated very clearly that auditory threshold trended to be changeable (tone threshold Decay test). Figure 4 shows that auditory threshold became changeable when continuous sounds from 40 to 70 db. in 1000 cycle were given. As is indicated in Figure 4, the patient did not become to percept sounds after continuous stimuli of 40 db. sound for 15 seconds. After that, therefore, the patient remained to be imperceptible toward the sounds even when elevated from 50 to 70 db. She could not percept sounds before stimuli attained to the level of 80 db. At the level of 80 db., threshold became no more changeable even when stimuli have continued for one minute.

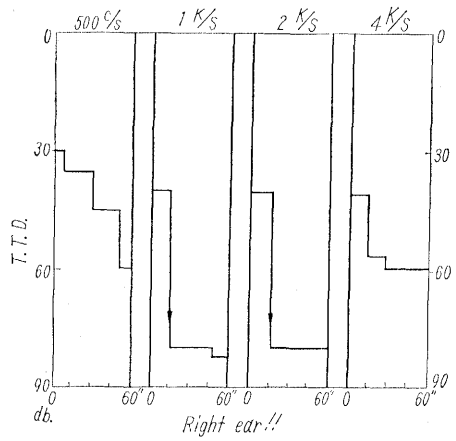
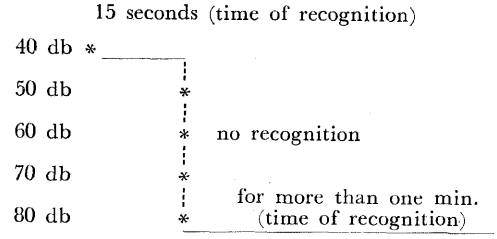


Fig. 4A. For each frequency the intensities are marked ordinate and time 0 to 60 seconds in abscissa.
The line slow evolution of patients throshold during this period.

Fig. 4B. (Schematic Figure of Fig. 4A)
Stimulation Sound 1000 cycle (T.T.D.)
15 seconds (time of recognition)



* stimulated point

As for the recognition of speech-sounds, we used 20 stimulous words consisting of popular nouns such as "train" "mother" "motor-car" "airplane" "cat" "dog" and "radio". The following results were obtained:

1) Recognition of word in the left ear: The number of stimulous words→20. Quality of stimuli→high intensity. Correct answeres→11/20

2) Recogition of word in the right ear: The number of stimulous word→20. Quality of stimuli→high intensity. Correct answers→14/20

Still more in order to investigate the recognition about speech-sounds in detail, the patient was asked to hear the words which were distorted through a 1300 cps. low-pass filter or a 1000 cps. hign-pass filter, and was tested to what extent the recognition of speech-sounds in the patient was influenced. The results obtained by such a testing were as follows:

3) In the left ear

The number of stimulous words which were distorted through a low-pass filter→20. Correct answer→3/20

4) In the right ear

The number of stimulous words which were distorted through a high-pass filter→20. Correct answer→5/20

Therefore the recognition of words was more disturbed remarkably in auditory testing with filtered words than in that with non-filtered words.

It was more interesting to us that her binaural discrimination of speech-sounds did not so much improved as in a normal adult when words distorted through a low-pass filter to one ear and words through a high-pass filter to other were given simultaneously. Exactly, in the testing toward the patient, the number of correct answers was only 5 out of 20 stimulous words. This result indicated non significance of summation effect.

Considering these results, the auditory threshold was disturbed more remarkably in the recognition of a continuous sound and of speech-sounds than that of interrupted sounds.

Till now we have been able to quote Stockert's an Richter's research as the study under the same aim to ours.

Stockert studied the relation between auditory perception and recognition of melodies. Richter studied the relation between auditory perception and word-deafness. They concluded that agnosia for melody or speech was due to instability of threshold of ability to discriminate differences of intensities of sounds as regarded as "phenomenon of Funktions-Wandel".

Our patient did not revealed also enough abnormality to explain the disturbance of speech-comprehension at the experiment in interrupted sounds but showed the instability of auditory threshold for the first time in the experiments in continuous sounds and in speech-sounds. Therefore it is obvious how important the testings of auditory threshold in both continuous sounds and in speech-sounds were in this case. Such an analysis seems to have been carried out insufficiently, while there were many studies concerned with the experiment about interrupted sounds in cases of disturbance of speech- and melody-recognition as long as reported up to now. Of course, according to our opinion, the agnosic phenomenon cannot be explained satisfactorily only from the point of instability of threshold in sensibility. But in order to elucidate the characteristics of each case which would be diagnosed under the same title as agnosia, it is necessary to examine whether thresholds of sensibilities are stable or not. In this point, we believe that this report will be contributable for the analysis about auditory threshold in cases diagnosed as pure word-deafnss.

Summary

This report is concerned with the case considered as pure word-deafness.

The predominant symptom of the case is confined to the disturbance of auditory recognition independently of disorder of hearing. Auditory threshold was examined not only in interrupted sounds but in continuous sound of word experimentally. Unstability of auditory thresholds was firstly found at the experiments in continuous sounds and in speech-words. Those results were discussed in comparison with Richter's and Stockert's reports. And then, it was concluded that the experiments in continuous sounds and in speech-sound is very important in such cases.

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