QUANTITATIVE EVALUATION OF THE STENGER TEST

Scott N. Reger, John P. Reneau and John E. Watson

Dr. Stenger described a procedure for the detection of auditory unilateral malingering in the year 1900. This test remains in use at the present time. Very little information has been published on the basic psycho-physics of the test, with the exception of certain studies on sound localization. The present experiment was designed to answer the following question: if one of two normal ears is stimulated with a pure tone at a given sensation level (SL), what is the minimum SL of the same tone in the opposite ear that can just be detected when both tones are presented simultaneously?

All sounds were produced by a single audio frequency source, which was divided by means of a "repeat" or "hybrid" coil into two separate signal channels, which were presented in phase to the two ears in earphones. This device insured synchronization between the durations of the simultaneously presented bilateral pulses.

Sounds consisting of 250, 1000 and 4000 cps pure tones, narrow band noise centered at these three frequency levels and speech in short meaningful sentences were used as test stimuli.

All signals were presented to the "constant" ear at the 30, 50 and 70 db SL's. The same signals also were introduced simultaneously to the "variable" ear at randomized SL's with a 2 db step attenuator. Each sound was presented bilaterally as a one second pulse or as a complete sentence. The sentences were reproduced from a studio quality, magnetic tape player — one sentence at a time. The subjects were instructed to judge if each pulse or sentence was heard in one ear only or if the stimulus aroused a sensation of awareness of sound being perceived in both ears.

Six normal hearing, acoustically unsophisticated subjects and six normal individuals, each of whom had had many hours of listening experience in auditory research, served as subjects for the pure tone measurements. The three frequency levels and three SL's were randomized within the limits imposed by the small number of subjects.

Thresholds were obtained on each ear for each type and SL of test tone just preceding measurement. The threshold of awareness of sound in both ears simultaneously was ascertained by the method of constant stimuli. This treshold was crossed ten times — 5 times in each of two listening sessions — for each classification and SL of test tone.

Threshold sensitivity measurements also were obtained at 1000 cps on the sophisticated subjects with a Bekesy audiometer while a 30, 50 or 70 db SL sustained tone was present in the constant ear. A few such measurements were obtained on untrained subjects. The Bekesy audiometer attenuator was of the continuously variable or stepless type, having an intensity rate of change of 2 db per second.

Subjects were instructed to press the audiometer signal key whenever and as long as they were aware of the presence of the variable tone from the Bekesy audiometer in the good ear and to release it as soon as this tone disappeared, and so on until the experimenter stopped the test.

Fig. 1 presents the mean values of the data. Curve U shows the pure tone measurements for the untrained subjects; T indicates the pure tone data for the trained subjects; N(T) shows the values for the noise measurements on the trained subjects; S(T) indicates the speech data from the trained subjects and B(T) the Bekesy audiometer data on the trained subjects.

Since considerable listening experience had been gained by the sophisticated subjects during the course of the experiment, the 1000 cps measurements were repeated on this group at the conclusion of the study. These data are shown by curve F(T). The differences in value and slope between the initial curve T and the final curve F(T) indicate the magnitude of the learning that occurred in the so-called trained subjects between the beginning and the termination of the experiment.

Fig. 2 shows a typical measurement made on an untrained subject with the Bekesy audiometry. It is obvious that this particular subject was unable to disregard the 50 db S.L. tone in his "bad" ear in spectacular fashion. Fig. 3 shows comparable measurements on one of the trained subjects whose threshold in the good ear was shifted only slightly by 50 and 70 db. SL's in the bad ear. The surprisingly small values of the shifts of the variable thresholds obtained with Bekesy audiometry shown in Fig. 1 and in these individual measurements of Fig. 3 are due in part to learning. However it is suspected that the smal magnitude of the shift may be due in part also to the alternate increase and decrease of the intensity of the variable while the "contant" tone was maintained at a fixed SL in the opposite bad ear.

To test this hypothesis an attachment for the Békésy audiometry was constructed which makes possible simultaneous parallel variation of both the variable threshold and of the constant. In Fig. 4 is a block diagram of one form of the equipment.

The threshold of the good ear is obtained while A 1 is set at the 0 level and 2 is set at the — 20 level.

After the Bekesy threshold curve stabilizes, A 2 is set at the 10 db level and at successively 10 db. higher intensity levels every few seconds until A 2 is at the 50 db. level or the threshold curve varies in its course. If the threshold curve remains steady when the 50 db. setting of A 2 is reached, either of two conditions prevail: (1) either the patient has a hearing loss in excess of 50 db. in the "bad" ear or (2) he is faking a spurious threshold. If the latter is suspected, A 1 can be set at — 20, for example for a foolproof check on the patients veracity. The following Figs. show the results of measurement on the trained ears. The results are interesting in the extreme. Not a single trained observer could fake a spurious threshold when the tone to the "bad" ear was at a 10 db. SL.

This test possesses the following advantages:

1. The test appears to be practically free from learning effects;
2. Experimental measurements on ears with unilateral hearing losses less than 50 db. indicate a high degree of accuracy of evaluation of the true threshold in the "bad" ear.
3. When subjects pretended that a slighty worse ear was the better ear, this untruth was quickly reveated;
4. The test does not need be administered in an exceedingly quiet room because of the automatic bilateral increase in intensity in both earphones as the threshold increases in intensity in the good ear;
5. Although the test can be used with any type of audiometer, if done with the Bekesy instrument a record of the subjects' responses is available on which every stimulus changed iniated by the examiner can be indicated; and
6. If the Bekesy audiometry is used, this superior test for the detection of unilateral auditory malingering can be administered by relatively unsophisticated audiologists, since it is exceedingly simple to perform. It is also simple to use with the ordinary clinical audiometer and far more accurate and decisive than the conventional Stenger test.

EVALUATION QUANTITATIVE DU TEST DE STENGER

Ce texte est une recherche sur les bases psychophysiques du test de Stenger pour la détection de la surdité unilatérale simulée.

L'expérience fût désignée afin de répondre à la question suivante: si l'une de deux oreilles normales rigorit un son à un certain niveau de sensation, quel est le niveau auditif minimum auquel le même son peut être perçu dans l'autre oreille lorsque le son est émis simultanément aux deux oreilles?

Les sons fûrent émis simultanément aux deux oreilles au moyen d'écouteurs par pulsation unique d'une durée d'une seconde. Pour l'oreille «constante» le son fut émis à un niveau auditif fixe, et simultanément pour l'oreille variable il fut émis à un niveau auditif choisi au hasard. Il fut demandé au sujet en question de juger si la pulsation était entendue dans une oreille seulement ou dans les deux oreilles.

En général, les sujets non préparés n'entendirent la pulsation dans les deux oreilles que lorsque le son variable se rapprocha du niveau de sensation du son constant; mais les sujets entrainés, en utilisant des indices pour la localisation du son, pûrent entendre le son dans les deux oreilles lorsque le niveau du son variable fût environ à la moitié de celui du son constant. La valeur du variable diminua d'une manière significative avec de l'entraînement. 250, 1000 et 4000 cps tons purs, bande de son étroite aux mêmes niveaux de fréquence, bande de son large et des paroles fûrent emis aux niveaux de sensation «constants» de 30, 50 et 70 db.

Scott N. Reger, Ph.D.,
Department of O.R.L. and
Muxillofacial Surgery,
University Hospitals,
Iowa-City, Iowa, U.S.A.

DISCUSSION:

Chocholle:

L'exposé du Dr. REGER m'a fort intéressé, car je poursuis depuis quelques années des recherches sur l'effet d'un son sur une oreille sur les seuils absolus, et les seuils différentiels de fréquence et d'intesité, mesurés sur l'autre oreille; j'ai ainsi entrepris depuis un an une recherche sur le seuil absolu en présence d'un son de même fréquence sur l'autre oreille; le son, d'abord largement infraliminaire, est brusquement accru, en présence du son contralatéral invariable; à une intensité suffisante après la variation le sujet s'aperçoit qu'il y a eu une variation (publication en cours de rédaction); les comparaisons seront utiles avec le travail du Dr. REGER.

Reger: (discussion not received).

Dr. Reger thinks the description is very clear, gives no comment.