MASKING THE TEST-TONE BY THE TEST-TONE

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The method of masking to be described is based on the following principles:

1. The test-tone and the masking sound are always applied by the same mode of transmission: for testing the air-conduction the masking is transmitted by air-conduction; for testing the bone-conduction the masking is transmitted by bone-conduction.
2. Masking sound is the test-tone itself.
3. The intensity of the test-tone and the masking tone must be absolutely identical.
4. The test-tone is presented intermittently, the masking tone continuously.

For the practical application we virtually need only a one-channel audiometer without any noise generator or other masking device. It must have, however, two earphones for air-conduction and two bone-conduction transmitters. Either earphone and either bone-conduction transmitter should have an interrupter. Of course, care must be taken that switching one earphone or bone-conduction transmitter on and off does not alter the voltage at the other one, giving rise to unwanted alterations of the emitted sound intensity. While the tone on one side is interrupted the tone on the other side is to remain constant. Using a two-channel audiometer this problem does not arise because both channels are independent of each other.

The patient is informed to disregard the continuous tone but to signal as soon as he hears an interrupted or pulsating tone. If we are not sure that he has understood his task we let him hear an interrupted tone of sufficient intensity as a preparatory demonstration.

For testing the air-conduction he wears both earphones as usual. The intensity in both earphones is held equal throughout the entire procedure. On the ear to be examined we give the tone intermittently; the ear to be masked receives the same tone at the same intensity but continuously. We may begin with a low intensity raising it until the patient hears the interruptions, or we may begin with a fairly high intensity lowering it until the patient ceases to hear the interruptions. By combining both ways we are able to determine the threshold exactly.

For testing the bone-conduction the patient presses both conductors against either mastoid. The procedure remains essentially the same: equal intensity on either side, continuous tone on the side to be masked, interrupted tone on the side to be tested.

I would like to add some theoretical explanations which seem necessary to a full understanding of the method. Suppose, we have a tone of 60 db

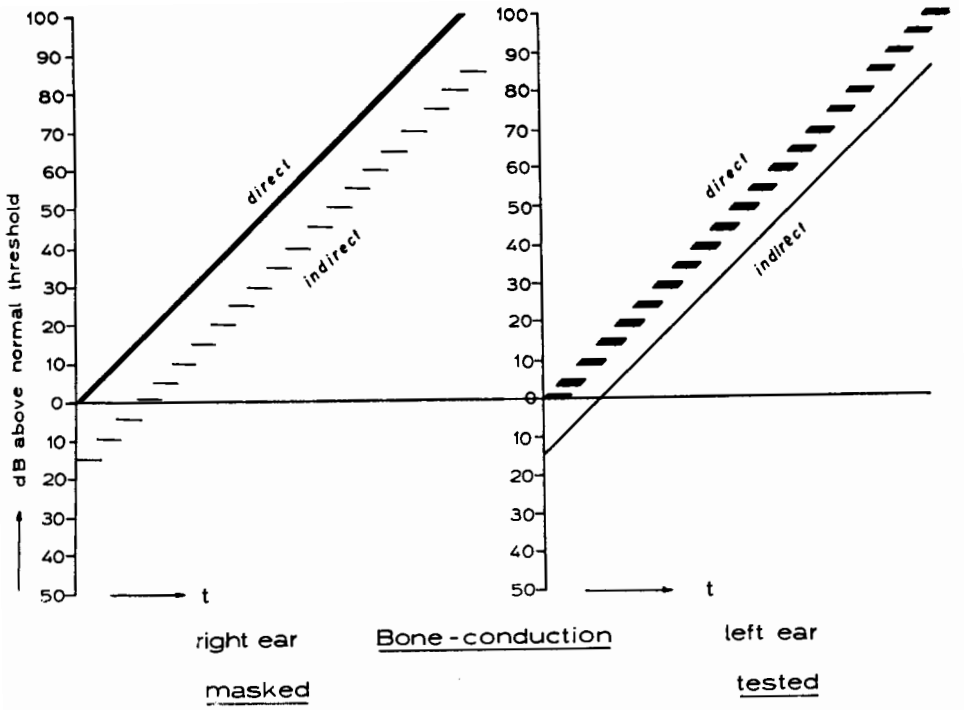

Fig. 1. Masking situation in testing the bone-conduction of the left ear. The same tone is impressed on both ears at exactly the same intensity, on the tested side intermittently, on the masked side continuously. The tone of either side is transmitted through the head, attenuated by about 15 db (indirect) and added to the direct sound. This does, however, not alter the intensity of the direct tone by a perceivable degree.

above normal threshold. Now we superpose on it another tone of the same frequency, the same phase and the same intensity. We have thus doubled the amplitude of the tone, but the intensity measured in our logarithmic scale has increased by only 6 db. 6 db is not very much, it lies well within the limits of error in routine audiometry. Now suppose, we add two tones of equal frequency and equal phase but of different intensity. Let this difference be 10 db. e.g. one tone being 60 db, the other 50 db. This will raise the total intensity by only 2.38 db; that means by adding a 50 db tone to a 60 db tone we get a tone of 62.38 db. Let the difference between both components be 20 db, and the increase of intensity will then be as small as 0.82 db. As a matter of fact it is also dependent on the phase relation between both tones; there may be no change of intensity at all or even a small decrease. But under normal listening conditions all these shifts of intensity will not be perceived. *)

*) One can, of course, insert a phase shift in one of the channels and adjust it so that both tones meet at either ear with an optimal phase-angle to keep the amplitude modulation at its minimum. This would enhance the reliability of the method without much expenditure.

Now in our method just this happens. Both ears receive sound from both sides. But the sound directly applied will always be at least 10—20 db louder than the sound transmitted from the other side through the head. Both tones superpose each other, the fraction coming from the opposite side, however, is so small that the resulting raise of intensity is imperceptible.

The diagram shows the relative intensity of the direct and indirect sounds on either ear, when the tones are impressed by bone-conduction. For air-conduction with normal sound transmission in both middle ears the difference between direct and indirect sound would be much greater, about 50—60 db, and that means the effect of superposition on the total intensity would be reduced to 0.028 db.

The result of all this is: the interrupted tone of the examined ear does not modulate the continuous tone of the opposite side to a perceptible degree, and vice versa the continuous tone on the masked side does not level out the modulations of the interrupted tone on the tested ear.

The method described secures an optimal masking for any conceivable combination of transmission and perceptive hearing loss between both ears. There is no risk that the masking may be either insufficient or that it may affect the threshold of the ear to be examined. The technique being always the same it need not be adapted to any special situation, and it can easily be carried out as a routine test be any trained assistant.

ASSOURDISSEMENT DU SON DE TEST PAR LE SON DE TEST

L' Auteur décrit une méthode de l'assourdissement pour l'audiométrie tonale liminaire basée sur les principes suivants:

1. Le son étudié et l'assourdissement sont toujours appliqués de la même façon: pour l'examen de la voie aérienne on applique l'assourdissement aussi par la conduction aérienne; pour l'examen de la voie osseuse on applique l'assourdissement aussi par la conduction osseuse.
2. La fréquence étudiée est également employée comme assourdissement.
3. L'intensité du son d'assourdissement et du son étudié (étant de la même fréquence) doivent être toujours identiques.
4. Le son étudié est émis de façon discontinue, le son d'assourdissement de façon continue. Lorsque le sujet perçoit les interruptions du ton, c'est le seuil.

Cette méthode procure un assourdissement automatiquement optimum pour chaque combinaison des surdités bilatérales.

H. Feldmann, M.D.,
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Reference:

H. FELDMANN: Neue Wege zur Vertäubung bei der Tonaudiometrie. Dtsch. Ges. HNO-Arzte, Sitzung vom 3.-7.6.1962, Mannheim. Under press in: Arch. Ohren- usw. Heilk. u. Z. Hals- usw. Heilk. 1962.