The Acoustic Window

A documentary of audiometer tested hearing tolerance in thirteen youngsters with conduct disorder and hyperacusis
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Thirteen youngsters with Conduct Disorder

From 2008 to 2010 thirteen youngsters were sent to be tested and treated at Ordblindeklinikken (meaning Dyslexia Clinic) in Hellerup. They were sent from a school for young pupils with different kinds of Conduct Disorder like restlessness. They were unable to stay within the frame of normal social behavior in school as well as in society. In a class with well-behaving pupils each of them alone could make the teaching difficult or impossible for the class as a whole. Their experiences in life often include criminality like assault and battery, plain robbery and bank robbery.

They have often been given a diagnosis like Attention Deficit Hyperactivity Disorder (ADHD) or psychoses. Many of them were prescribed daily medication. They generally were heavy smokers, and many of them drank, smoked hashish and might use cocaine too. They often suffered from insomnia, nightmares and headaches that occurred when they were or had been exposed to noisy environments. Among them were people who without warning would explode in furious rages. Some of them felt harassed by spirits. More often than not they were unable to develop literary abilities like reading, writing and spelling.

The Hearing Tolerance

The thirteen youngsters were sent to Ordblindeklinikken in the hope that treating them with the sound of the “Volf Acoustic Records” used at the clinic as therapeutic means, might adapt them better to the conditions of school-education.

When a person shows distorted reactions to their surroundings, as those youngsters generally did, it may well be because his or her perception is likewise distorted. A connection which makes it reasonable to investigate their senses closer.

One of the (very few) objective tests of perception that can be performed is an audiometric test of the hearing sense. More specifically: The Hearing Tolerance: The hearing tolerance is the span between the Threshold of Hearing (THR) and the Uncomfortable Level (UCL) as measured on the clinical or diagnostic audiometer.

As the hearing dynamics represent one of the great windows of Man’s sense-perception and means of communication, I found it reasonable to call the hearing tolerance The acoustic Window and hence to provide this paper with the same name.

I shall present each of the thirteen one by one, portrayed by their audiogrammes:
Number 1

2008-08-13 the school sent a thirteen and a half year old male. A normal school could not handle him. He was medicated with Ritalin. He walked stiff as if in a trance.

He didn’t like eating, and was intolerant to glutamine. He was seized by sudden outbursts of violence and rage. He felt harassed by a teasing spirit. His schoolmates avoided him. He showed great problems with reading, spelling and writing; although he was able to write – or rather draw – his full name.

Determining the Threshold of Hearing – THR – on a pc-based audiometer

For reasons later to be explained, it is necessary to achieve the cooperation of the person whose hearing dynamics are to be determined. Therefore the thirteen years old youngster is situated next to me, and the audiometer screen is as visible to him, as it is to me.

The audiometer applied is a pc-based Siemens Unity. The test-signal is a pulsating tone. Its volume is changed in intervals of 5 dB.

We start with left ear, 1 kHz, 40 dB. If it is the person being tested that operates the volume-button during the test, he or she is instructed to diminish the volume, until the tone no longer can be heard, and then to go back and find the volume where the tone can accurately be perceived. Then to press the button in order to mark the threshold of hearing for that tone. If the person being tested is unable to operate the volume-knob, I do it myself.

When the threshold is agreed, I change to 750 Hz, 40 dB, and the procedure is repeated. Later we proceed to 500 Hz, 250 Hz and to 125 Hz. We then shift to 1,5 kHz, 40 dB and from there go to 2-, 3-, 4-, 6- and finally to 8 kHz.

Now the test continues with the right ear, 1 kHz, 40 dB, and the same procedure is followed. The outcome 2008-08-13 was the audiogram below:
The conduct of this person is – as before said – heavily disturbed. Therefore one might suspect that his sense perception is likewise disturbed, and that the disturbed sense perception would match a likewise disturbed threshold of hearing. This seems not to be the case. His THR as tested on the audiometer shows within the limits of what is normal. In fact so normal that one could say, that his threshold of hearing looks very undisturbed.

The question is: What is it that we have measured with the audiometer? Is it his threshold of hearing, or is it maybe his feeling senses that show?

The only way to find out is to leave the headphones of the audiometer untouched on his ears and continue with the test, finding the Uncomfortable Level or UCL for each audiometer-tone.

Determining the uncomfortable level of the eardrums, using the audiometer

The audiometer is changed to the UCL-setting.

The person is explained, that now we test the limit where the tone from the audiometer may be perceived as uncomfortable, as a tickling in the ear or as pain. Whichever comes first. The person is asked to say “stop”, to raise a hand or to look disturbed when one of these levels is reached. I then position myself so I do not have to look at the screen, but instead can look on the person. The person being tested has the screen in full view. This is to make the person tested comfortable and secure. He or she must have access to know what happens. To have a potentially painful sound applied to the eardrums by headphones is a vulnerable position to be in. Every means to diminish the vulnerability, the person may feel, should be taken.
The audiometer has the following upper limits:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Limit</th>
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<td>125 Hz</td>
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<tr>
<td>250 Hz</td>
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<td>500 Hz – 4 kHz</td>
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<td>6 kHz</td>
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<tr>
<td>8 kHz</td>
<td>100 dB</td>
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</table>

The test for UCL starts with 125 Hz, left ear. The duration of the tone now is manually controlled. Its duration is around a second, which is enough for the eardrum to react.

As the threshold of hearing for the said tone on the left ear has shown to be 15 dB, the test must start here.

If 15 dB is not perceived as uncomfortable, the level is raised to 20 dB and from there to 25-, 30-, 35- and so on.

Now we test tone for tone, and for each tone marks the level where UCL is obtained, until we reach 8 kHz. Each new tone is started at least 20 dB below the level of the UCL level of the foregoing tone or – when such a level is not found – always at least 40 dB under maximal level.

When the UCL test on the left ear is finished, we proceed to right ear and again start with 125 Hz.

It is utmost important that the person tested is never questioned whether the limit given is true or not. Many pupils who show literary disabilities will also try to hide their shortcomings. If questioned, they might think that what they experience as uncomfortable when it comes to sound pressure, will be regarded as abnormal. Many of them are probably already aware that their literary level is below average – and all they really wish for is to be normal. Therefore they develop a keen instinct to hide anything not normal. This goes for both the teacher in school and me, if I start questioning the UCL results.

What can be permitted is to ask the person what kind of uncomfortability he or she experiences. Concerning the young man being tested, he explains that the uncomfortability he perceives is a feeling of nausea in the body as such.

Hearing Dynamics of the first youngster

After testing we have an audiogram of both the level of THR and of the UCL of this person:
The center of the “U” marks the level where UCL was reached.

It should be appropriate to regard the test of threshold of Hearing – marked with X and O’s – as a test of the sensibility of the organ of hearing, and the U’s that mark the level where sense of feeling and/or pain begins, as a test of the over-sensibility of the eardrums.

Sense-confusion

What we tested with the test for THR was after all not the threshold of hearing alone, but some feeling sense as well. The audiogram shows a short-circuit between hearing and feeling sense. A sense-confusion.

On the left ear there is a minor difference making a minor dynamic range of hearing not exceeding 20 dB, with regards to the lowest audiometer tone. The dynamic range diminishes until we reach 4 kHz where the two levels are identical and stays so at 6- and 8 kHz. On the right ear the levels are identical at 500 Hz and at 1- and 2 and 4 kHz.

Ideally the hearing dynamics should be more than 120 dB on the four mentioned tones on right ear. We might say that the hearing tolerance or hearing dynamics here lack more than 120 dB. We might just as well say that the hearing tolerance is nil. The hearing sense tested on the audiometer appears to be collapsed.

If the curves represented an amplifier and the UCL is its own noise, we might say about that amplifier that its linearity could have been better, but that the non-existing Signal-to-noise Ratio (S/N) makes it useless for any practical purpose. Only we are not dealing with an S/N ratio here, but with a THR-to-UCL ratio.

There is a technical question here: When testing the THR, the
young man tolerated audiometric test volumes up to 40 dB without complaining.

How come?

Maybe the duration of each pulsating tone from the audiometer is so short that they do not trigger the feeling of uncomfortability, sense of feeling or pain in the eardrums. Experience shows that generally a tone should last more than half a second to do so.

The threshold of hearing and the uncomfortable level are so inter-mixed, that it is impossible from the audiogram to determine what the young man hears, and what he feels. When addressed orally, he might just as well feel what is being said, as well as hearing it.

He talks. When in a quiet room and addressed in a low voice and face-to-face, he understands most of what is said, and he is able to answer. Feeling senses are not made to discriminate speech. Still the audiogram shows confusion of senses.

His obvious vulnerability towards sound levels that do not hurt other people, can be regarded as a distortion of sense perception, namely the distortion that is called Hyperacousia. The distortion might very well explain his distorted behavior, his distorted psychic functions and also his lack of literary abilities like reading, spelling and writing.

Hyperacusia in literature

There is not a lot of literature on hyperacusia. A condition that plays an important role for sense perception and therefore for the quality of life for many people.

The earliest description of low hearing tolerance that I know of, is:

Christian A. Volf: **Audiometric Hearing Tolerance Tests.**
Columbus, Ohio: Private print, October 23, 1944. It can be found in Copenhagen at Universitetsbibliotek Nord. Volf was a self-taught Danish-american physicist.

He announced:
Case History:
Hearing Impairment
First noticed
18 years ago.
Childhood diseases.
Minimal, including skin.
Measles, pneumonia.
No family history.

Hearing aids: No.
Have third severe.
Noisy - difficult.

Sound Pressure Tolerance Test
Above hearing threshold values.

<table>
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<td>10</td>
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<td>20</td>
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</table>

Hearing tolerance must be at least 50 dB above audiometry.

*Caption at bottom:*
Copyright 1956 by C. N.
“Hearing Tolerance” is what I here have chosen to call Hearing Tolerance or Hearing Dynamics. Volf not only tests the tolerance on audiometer; he also treats the hearing sense of a patient with low hearing dynamics with the sound from nine “acoustic” 78-records through headphones. He labelled each of them “Volf Acoustic Record.”
In Danish the topic is described in a peer-revisited (by professor Med.D. Bengt Zahcau-Christiansen) article in a magazine: Kaare p Johannesen: **Den langsomme hørelse**. In: Dansk Audiologopædi nr. 4, 22. årgang, 1986. S 148 ff.

**Steadman's Medical Dictionary** and **Butterworth's Medical Dictionary** defines "Auditory hyperalgesia" as “Painful reaction to noises not ordinarily unpleasant” and “a condition in which noise causes acute pain; an extreme form of hyperacousia.” On Hyperacousia Butterworth writes: “excessive sensitiveness of the skin, due to local causes or to peripheral nerve trouble:”


The author mentions on p.10 the topic of:

“- what we call the *neural representation* of sound from various portions of Clay’s central auditory nervous system.”

“Clay” being a boy of an age corresponding to kindergarten who has been in speech and language therapy for a long period. He fully resembles the problem with low range of hearing tolerance that is the topic of this paper.

"Results of Clay’s testing indicated that the lower part of his central auditory system, such as his brain stem, responded exactly as they should to sound. However, as we moved higher in the nervous system, the responses to sound began to diminish. Finally, at the level of the brain itself, or the cortical level, Clay’s responses to sound were extremely reduced, especially over the left hemisphere of his brain, where actual speech-sound processing takes place.”

This passage indicates that the sound activates the lower levels of the brain, where feeling and pain are sensed, instead of activating the higher levels belonging to the perception of hearing.

On APD: See Christian Worsøe: **Når hjernen ikke kan høre**. In: Psykolog Nyt nr. 6 – 2004. An article mainly based on Teri James
Bellis; *When the Brain can’t Hear*, mentioned above.

The thirteen-year-old male I tested on 2008-08-13, may benefit from having his hearing sense separated from his feeling senses. This can be done using the Volf Acoustic Records that exercises the powers – the properties – of the inner ear in much the same way that a muscle can be exercised: Tire it out! When it regains its powers, it will be able to carry a bigger load. In the same way, the hearing dynamics can be trained systematically by tiring the inner ear. When it recovers, hearing dynamics is expanded.

The muscle has a recovery function. The same goes for the hearing sense.

**Treating hearing sense on a resonator**

Prior to the playing of a Volf Acoustic Record, Volf placed his patient in a sitting position on top of the front-speaker of a very big loudspeaker that he had build around 1930. From the outside it looks like this:
The loudspeaker is two meter high. It is 75 cm wide, and the length of its bottom is one meter and a half, giving the cabinet a total volume of over 1,100 litres.

On top of the construction is a 12" Peerless speaker of 16 Ω. On the lower front a similar speaker with the impedance of 8- is found. When I received the construction, the two speakers were coupled in series, giving the speaker on top twice as much energy as the one at

(From Kaare p Johannesen: Kurér ordbblindhed! København: Borgens forlag 2010, p. 350)
The cabinet contains 510 resonance tubes like the tubes found as part of the flutes in a church organ. The container underneath is a water basin. When the loudspeaker is used therapeutically, the basin is filled half way up with water.

This is the spectrum of sound from Volf’s loudspeaker. The built in resonance tubes are seen to amplify the sound where it hits their individual resonances and their overtones. Volf called this loudspeaker a “Resonator.” I will do likewise.

To use Volf’s original resonator in a house where other people live, is forbidden. The sound will fill the whole house, and if there is a connection to the house next door, it will fill that house too. I have tried. The sound of that resonator is by no means easy to tame.

So I stored the “monster” and build a copy that could fit in an existing noise-isolated room. I constructed two cabinets and water basins with a volume of a little over 500 litres each. My double-resonator contains 2 x 24 resonance tubes, generally giving resonance for lower tones than Volf’s original does. To solve the problem of giving the top speaker twice the effect of the bottom one, I use four 8” speakers on top of each cabinet and two at the front. As the amplifier cannot handle six speakers coupled in parallel, I divided them in three series-coupled entities, which then are coupled in parallel, giving a total impedance of more than 5 Ω.

The left side of the copy shows the following spectrum:
The resonance tubes show on the curve in the time between approx. 5 and 13 seconds. Eighteen of the tubes are seen to give resonances and overtones. Six of them look less clear. The reason being that the test sound is not continuing. It consists of little steps up the frequency ladder. The tones that match the resonance of these six tubes exactly were not present.

The young man is seated on the resonator at Ordblindeklinikken. He chooses to hear the rapper Eminem. He is then instructed to give signal as soon as the music begins to trouble his hearing. I start at a volume that is so low that it cannot be measured, and gradually let the volume increase. When we reach a volume of over 60 dB (measured on Loudness Meter, A-Frequency-weighting Filter, Average, Sound Pressure Level, Spl) he gives the signal. At this relatively low volume he hears Eminem sing for five minutes.

All sound levels later mentioned in this paper in connection with sound therapy are measured the same way: Loudness meter, A-weighted, Spl, and Average.

When treating young people on the resonator I use between eight and fifteen minutes of music. When the volume that the treated person tolerates is as low as it is here, I mostly prefer a series of short pieces. Between each piece I will ask: “Can I increase the volume some?” Sometimes I can’t. Sometimes it is possible to increase the volume with as much as 20 dB during a single treatment.

Treatment with the sound of Volf Acoustic Records

Next step is to let the young man hear the sounds of a Volf Acoustic Record.
Intentionally I don’t use the phrase “listen to.” Prior to playing the recording I tell him that it is not necessary for him to listen consciously to the five minutes long series of sounds. He shall just be there. He may sleep, if he feels like.

Some in fact do fall asleep.

I can’t know how this young man’s hearing sense will react towards the “acoustic” sounds. Even when the audiometer test shows no hearing dynamics, some may be able to tolerate the music from the resonator at 90 dB without any trouble. I have no way of telling the level beforehand. Likewise some might show the ability to tolerate any sound pressure in the headphones when the topic is Volf’s sound coming from Volf Acoustic Records. Experience has shown that the sinus tones from the audiometer, the Volf sound and the hearing in free field of music from a resonator represent three different tasks to the hearing sense, and that the sense may react very differently towards each of them.

This first time I take my precautions. I instruct the young male that if the sound is uncomfortable, he can signal to me to have the volume reduced. If the sound hurts in his ears, he shall take off the headphones immediately. I use a Nagra IS with its very fine but weak built-in headphone amplifier. The volume in the headphones is in the range of over 50 dB, and less than 60-

When I treat a person, I hope that next time the person comes; he or she will be able to tolerate a higher volume than before, in the same way that I do on the resonator.

I start the record with the headphones on my own ear to make sure that everything is as it should be. Then I put them on the person to be treated. The volume being the same as it was the last time. After a moment I start increasing the volume until the person in treatment gives the signal to stop increasing. But this first time with this young man, I leave the volume where it is.

Afterwards the young man tells me that he might have tolerated a higher volume, but that the sound anyway gave him a headache. The sound used was Volf Acoustic Record 187.

Frequent side effects of treatment

The first effect of acoustic treatment of hearing sense with resonator and Volf Acoustic Records is often fatigue. We see lively children coming in and the same children walking tired out again. Especially during the first treatments. We take this as a sign showing that the therapy has the desired effect.

The treatment may give a headache. Once again a side effect attached to the first couple of times of treatment. When it happens, we
try to make the treated person drink a glass of water before leaving. They may also experience a piping tone in the ear like tinnitus. It’s not tinnitus. It’s a tired hearing sense beginning to recover, using the recovery-function of the ear.

Expanded hearing tolerance or hearing dynamics may alter the way of talking, standing and walking. Very often it alters reading, spelling and writing. Especially the gain of reading ability is a side effect often wished for.

Some technical information

In the Appendix I give a closer description of Volf Acoustic Records. But it may be appropriate to say a little about the copies I use for treatment and the technical apparatus:

Volf wanted the original recordings to be played on a normal 78-gramophone player, a small amplifier and headphones. The headphones of his time were the old 2000 \( \square \)-capsules with a plate-membrane and a centre magnet.

When I got hold of Volf Acoustic Records I had a professional lab do a set of master tapes in 15”/second and mono. From the master tapes I make 15”/sec. copies in mono using a Lyrec and a Studer tape recorder, and 7,5”/sec. for the Nagra IS. All three machines use mono heads.

When playing the copied tapes on the Lyrec and on the Studer, I make use of amplifiers build at Danmarks Radio. They have very good sound and their S/N is unsurpassed by anything I have ever met before or since. The amplified signal is played through headphones with capsules that cover the outer ear.

Treatment of Number 1

More then three weeks after his first test – the date is 2008-09-12 – he returns. On this day his prescription of Ritalin has been stopped. He also has had a consultation with chiropractic. He feels a great personal success. Again he hears Eminem on the therapeutic resonator; this time he tolerates a sound pressure of more than 80 dB. In headphones he is exposed to the Volf Acoustic Record named 348. First he signals: “Stop!” when we reach 80 dB, but after some time he has the volume reduced to 70-.

I don’t audiometer test him every time he comes. But by registering where he stops the increasing of the volume of the sound from resonator and from headphones, I have a picture of what happens to his hearing anyway. As long as he tolerates more, I use the expression that his hearing sense is “opening.”
Seven days later I see him again. He now accepts that the music (Prodigy and Jamiroqui) is gradually increased to between 80 and 90 dB. Very close to the maximal sound pressure we use where the resonator is concerned. This day I administer Volf Acoustic Record 802 to him with a sound pressure in his ear that is over 90 and less than 100 dB. Which he accepts. But he definitively doesn’t like the sound of the 802.

2008-09-26 he reaches over 80 dB on the resonator, and 2008-10-03 he tolerates full volume, which is more that 80-, but still not 90 dB.

Reportedly he is not seized by rage anymore. Which in this case may not be due to the sound treatment, but to a very potent antipsychotic that is administered to him now, a product named Abilify.

He is treated four more times before the second test. Over a period of three and a half month he has received nine treatments, each lasting around twenty minutes. Aside from what is mentioned before, he also has been treated with Volf Acoustic Record 801. All in all four of Volf’s nine recordings have been in play. 187, 348, 802 and 801.

2008-12-12 his audiometer-tested hearing has changed:

Now the linearity of the THM is worse, but the THR-to-USB ratio has gained 35 dB what 2 kHz right ear concerns.

The Acoustic Window

If we look at the audiogram we see hearing dynamics now reach as much as 50 dB at 1 kHz and 55 dB at 1,5- and at 6 kHz kHz on the right ear. The left ear even reaches 65 dB and 60 dB at many

![Audiogram](image-url)
frequencies. But for the right ear 250 Hz and 2 kHz show a dynamic of 35 dB. Therefore the hearing as such can be said only to possess a THR-to-UCL ratio – a hearing dynamic – of 35 dB.

The audiogram shows what I have – as before mentioned – has chosen to call The Acoustic Window. As dB is a logarithmic scale, the window is extremely narrow and still does not allow much sense information transmitted to the central nervous system. The young man is still in a state of sense-confusion, but at another level than he showed first time his hearing was tested on the audiometer.

As poor as the acoustic window is, it still represents an increase of 35 dB on the left ear. On the right ear, 1 kHz shows an increase of 50 dB. A tone where the first test showed no dynamics at all. When we come from zero, we might claim that this young persons hearing tolerance or hearing dynamics has improved infinitely many times. That would have been the case, even if the gain had been only 10 dB. The hearing sense and the feeling senses now show a much higher grade of separation.

His acoustic window was closed. Now there is an opening, even if it is only the size of a crack.

What made the improvement of the hearing dynamics of the young man happen?

Normally an improvement like this might have been considered to represent the combined effort of the treatment with chiropractics and with sound that the young man has undergone. The factor of uncertainty here is that the Ritalin was stopped, and the medication with Abilify took place instead. Both drugs are destined to alter sense perception. They most likely have done so. However their effect on audiometer-tested hearing is not known.

The thirteen-year-old male has started reading on his own. This I believe to be the possible effect of a better functioning inner ear as such.

Here we have a cardinal point:

In the inner ear we find the organ of equilibrium. An organ that controls the movements of the eyeballs. The automatic movement of the eyeballs is necessary for automatic reading. When a person – a pupil – is unable to develop reading, the reason for this shortcoming could very well be a shortcoming of the said organ. The inner ear is a very small entity containing two organs. These two organs share the Perilymph, a liquid system of about 20 µl, making the two organs very dependent on each other. When the organ of hearing is in a state where the acoustic window is closed – as it was with this young man 2008-08-13 – there is every reason to believe that the organ of
equilibrium functions badly as well and therefore is unable to handle the control over movements of the eyeballs.

When we see the acoustic window open, there is reason to believe that the organ of equilibrium has profited too. A sudden developing of reading ability indicates in my mind, that it has.

The better functions of the inner ear as such may be due to the acoustic treatment or to the altered medication. Or may be to a combination?

After this second test the young man received another eight treatments at Ordblindeklinikken, making use of Volf Acoustic Records 189, 802, 190 and 611. When leaving the clinic after a last session 2009-06-12, he behaved very well in school. He had contact with his schoolmates.

Twelve more youngsters. Each of them representing a worst-case scenario

The teacher that selected pupils from his school to be tested and treated at Ordblindeklinikken, sent a total of thirteen, consisting of ten males and three females. Seen from a normal schools point of view every one of them could in many ways be said to represent a worst-case scenario.

When selecting a group to be represented in a paper like this, the current selection could easily contribute to giving the outcome a certain tendency that could support a wish, I may have had beforehand. To avoid that, I have used the entire group, the teacher selected. None subtracted, none added. His selection being based on which pupils he considered would benefit the most from an acoustic treatment. Which as it turned out resulted in a paper with a certain tendency, namely to investigate the properties of the acoustic window on thirteen youngsters, carrying diagnosis like ADHD and/or mental disturbances and heavy literary disabilities.

Limitations

Of the thirteen youngsters some were prescribed psychochemical drugs. If I’m told, I write their prescriptions in the journal, but later I don’t ask additional questions. I have no wish to raise the suspicion that I am trying to make them stop their medications.

Also I don’t ask if they have started reading and writing. Even if they are sent to Ordblindeklinikken in the hope that treatment with sound will make them develop reading and writing abilities besides calming down their behaviour. I still maintain that our clinic neither treats behaviour or literary abilities. We treat the functions of hearing
sense, and thereby we treat the properties of the inner ear as a whole. If the people treated start reading or writing or – maybe more important – are able to cooperate better in the school, this is to me only side effects of having the functions of their inner ear improved.

When the school reports positive results from the treatment their pupils receive at Ordblindeklinikken, I am not informed if “positive results” means that the pupils are easier to handle or if it means that they develop reading or writing skills.

This goes for their relations to drugs and smoking too. Being a chain smoker, a hash smoker, a cocaine user, a regular drinker and so on is likely to be regarded as socially acceptable behaviour inside their society of schoolmates. To do none of these things on the other hand could easily be unacceptable among them. I have no right to try to impress my standards on them.

I do one little thing with regards to their literary ability: As part of the test I ask them to write their name. When testing again I repeat my question, and afterwards compare the results. As they contain personal information – the names – I can’t show this documentation. But I can use it for my own clinical insight.

So the rest of this paper will mainly consist of objective audiograms, while I one by one report about the individual pupil tested and treated.

Number 2

Twenty-year-old male. Trying to get an education. Can’t read, write or spell. But he does write his full name when asked. He bites his nails.

2008-02-01 we make this audiogram:
Very little hearing dynamics, very little THR-to-UCL ratio, very little acoustic window. Only his sense-confusion looks big. Here I refer to the heavily distorted THR-curve. He shows over sensibility to sound.

On the resonator he is applied the sound of a Japanese drum-orchestra at over 80 dB. In headphones he is applied the sound of Volf Acoustic Record 348 at a volume around 90 dB and accepts that too.

A week later – in the first week of February – he returns and hears ten minutes of a Janis Joplin record on the resonator at full volume. When treated with 187 in headphones afterwards, he feels the sound working behind his eyes. This clearly shows that his sense-perception still may be somewhat distorted.

In the month of February he comes three times more, hearing 802, 348 and 801. In March he does not show up. In April he does, and is given 187, 348 and 802 at increasing volumes. 2008-05-09 we test again:

Let the change of opening of the acoustic window speak for itself. It was achieved without the support of chiropractors.

Might sound therapy damage hearing?

During the acoustic treatments, considerable pressure of sound is administered to the ear. Which should cause some concern: Might hearing show damage afterwards?

In 1961 the Danish Ministry of Education arranged an experiment treating the thirteen most literary handicapped pupils – ten boys and three girls – in the third and fourth grade in the schools of Fredericia with Volf Acoustic Records 348 and 611. Curiously enough the same amount of people and with the same distribution of sex as in
this paper. The experiment was supervised by an audiologist. The organizers of the experiment in Fredericia had not expected any effect at all. To their astonishment all thirteen increased their ability to read aloud from an unknown text. The most helpless reader increased his reading with more than four hundred per cent.

Was their hearing unaffected by the loud music and sound? In his report in *Ugeskrift for Læger* (Doctor’s Weekly), audiologist Buch-Sørensen, MD, who led the experiment, stated that the hearing of the thirteen children from Fredericia treated with Volf Acoustic Records did not alter (when measured on the audiometer).\(^1\) As the audiometric measured hearing often alters significantly when treated with Volf’s sound, and must have done so for at least some of his thirteen, I believe that what Buch-Sørensen really wanted to point out was that the relatively high volumes in headphone-treatment didn’t harm the threshold of hearing, contrary to what high volumes in headphones generally is believed to do.

A number of people in Denmark have been treated with Volf’s sound since 1957. Damage to hearing sense has never been demonstrated. Even when some of the therapists have had little qualifications with the acoustics.

The young man said: “Ligesom der var dug på et vindue, sådan havde jeg det med øjnene før.” “Before it was like my eyes were covered with dew – like on a window.”

He still bites his nails.

In May and June he is treated four times and is given Volf Acoustic Record 189, 190, 802 and 189 again. He then disappears and is not tested further.

He now is able to read. He attends a traffic-school to get a driver’s license, and here he is among the three best in his group.

His brother was:

**Number 3**

His brother is sixteen. He sleeps badly. He is prescribed Ritalin and behaves disturbed and is very disturbing without it. He bites his nails as far up as it is possible to bite them. He is unable to develop reading and writing abilities. Indoors as well as outdoors he wears a hood over his head. He smells strongly of cigarettes. He’s very hard to get in contact with. The date for his first test on the audiometer is 2008-02-21:

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\(^1\) C. Buch-Sørensen et. al: *Behandling af ”ordblindhed” med Chr.A. Volf’s metode*. København: Ugeskrift for Læger 124/35, s. 1295 ff.
The reason that he always wears a hood could maybe be that he tries symbolically to lock all kinds of sense perception out. Here I’m referring to the observations that the people who have been training, for example, ADHD children in institutions have reported. Some of the children will put their thumbs in their ears and use the four remaining fingers of either hand to cover their eyes. They are oversensitive to sense-perception of any kind. He may be the same.

He hears George Michael at full volume on the resonator and also takes a Volf Acoustic Record 187 at around 90 dB in the headphones.

The day after he comes again, as he accompanies his brother. He is now more relaxed and he is easy to contact. He has slept undisturbed the whole night, which is unusual for him.

In March – a month later – he gets one treatment and in April he is given four. The Volf Acoustic Records used are the usual from the low register that normally starts a therapy: 348, 801, 187 and 348 again.

2008-04-25 we re-test hearing dynamics:
The remarkable dive at 4 kHz in THR left ear makes the THR-to-UCL ratio worse that it was when first tested. What has happened?

The young man limps. The day before a computer screen fell and hit his big toe.

After one more treatment – when his toe has healed – I have him tested on the audiometer again to see if the dive at 4 kHz left ear persists.

2008-05-16:

It doesn’t.

In August this sixteen year old has reduced his intake of Ritalin. His mother has been forced to spend summer holidays with him. Normally she hates it, but this summer vacation turns out to be a success for both of them.
He now starts a new series of treatments where mainly Volf Acoustic Records belonging to the higher registers are used: 802, 189, 190, 802 again, 189 again, 190, 611, 189.

2008-08-22 we test for the last time:

![Image of audiogram graphs]

The gain in THR-to-UCL ratio from first test is 10 dB. It doesn’t sound impressive, but his subjective achievements are appreciated among the teachers in school as well as in his family. There seems to be no need to maintain therapy. By the way, he still bites his nails, but he no longer hides behind a hood.

Number 4

Young woman. Eighteen years old. She writes her first Christian name. She is unable to write the next, which has three letters. Her family name is a three-letter name too. She is unable to write it. She has an ADHD diagnosis. She cuts herself.

2008-04-24 she is tested on the audiometer:
Test for UCL was stopped when I found out that she suppressed the pain from the sound of the audiometer and was unable to do otherwise. The fragmented UCL-curve on left ear therefore is not trustworthy. On right ear UCL is not tested.

On the resonator she tolerated full volume, and I believe that was correct. I gave her the Volf Acoustic Record 348 in headphones from the Nagra. She claimed that the sound was irritating, while constantly knocking her heels on the floor. After two and a half minute she took off the headphones.

I didn’t see her again until August after summer holidays. This time she kept the headphones from the Nagra on for the five minutes that 187 lasts. Second time in August she was able to hear it from the more powerful amplifier on the Lyrec tape recorder.

She came once more. In September.

Number 5:

Is fifteen years. Seized by sudden violent rages. Illiterate. He is tested on the audiometer 2008-06-13:
I have contemplated how it would be to have sounds from the outside world coming into the senses like it does to this young man. Maybe I could configure an equalizer after these curves and try. I would need an amplifier with a signal-to-noise ratio not exceeding 50-60 dB for the experiment, and then lower the distorted signal 20 dB under normal volume to create a sense-confusion similar to the one that is seen in this first audiometer test. I wonder if I then could tolerate to be inside a classroom and how I would react, if somebody talked to the class as a whole. Or tried to educate me.

Two times in June, two times in August, two times in September and once in the beginning of October he is treated with resonator and with Volf Acoustic Records. 2008-10-24 we test again:
This is worse than before. But at school they are experiencing that the desperate conduct is much suppressed, and it is now possible to educate him.

He comes for three more treatments in November. We test again 2008-12-05:

I had hoped to send him out in the world with a better acoustic window than it was when he first came. This audiogram is objectively worse. The subjective side is that now he feels fine. The explosive temper making it impossible to reach him has dissolved. To day he still does well, and is learning to be a cook. His teacher told me his final words when he left the school. They were: “I want to thank you for all, you did for me.” Meaning the treatment that the teacher had me give him.

I have no means to explain this subjective outcome from the objective audiometric data. The audiometer data says sense-confusion. His conduct does not anymore.

Number 6

Sixteen years old. His pelvis is obviously maladjusted, making him move very badly. He bites his nails. He can read and write some. But it is clear, that he needs some kind of help. I make the school send him to a chiropractor.

I have an audiogram from 2008-11-14:
Even if this looks better than many of the other pupils from this school do after treatment, this is neither a normal nor an attractive audiometer tested hearing.

This young man comes five times more in August and September.

Number 7

He is fifteen. Much disturbed. He is prescribed Ritalin. Two times ten mg a day. He has great problems with reading, writing and spelling, the school says. He can draw his prename when asked. (I wouldn’t say, he writes it.) This is 2009-01-16:

He agrees that he suffers from tinnitus. I often ask that question when
an audiometer test shows extremely low dynamics at 6- or 8 kHz.

Please imagine having to use an acoustic window as distorted as this. With that kind of hearing I personally find there is good reason for the amount of medication he is prescribed.

On the resonator he accepts Kim Larsen at over 70 dB. In the headphones he takes Volf Acoustic Record 187 on the Nagra, much subdued.

Over the next three months he gets eight treatments and gradually accepts higher volume on the resonator, until he reaches the clinic’s full volume.

2009-05-07 we can test again:

His hearing has “calmed down,” and his acoustic window has opened somewhat. He is reported to behave much better in school. He still gets ten mg of Ritalin twice a day. He can still only draw his first name.

Part of the picture is that this youngster has shown himself to be intolerant to glutamine and refuses to live accordingly. Meaning that he is constantly intoxicated and poisoned by products containing glutamine.

The treatment on Ordbindeklinikken goes on with thirteen sessions until 2010-11-11:
I would consider that he has gained more than 60 dB in hearing dynamics. He is reported to function very well now. This may mean, that he reads. He now writes part of his family name too.

I don’t know if he is still medicated. At least the teacher claims that he finds that Ritalin is no longer necessary.

Number 8

She is sixteen. Has trouble reading, writing and spelling. She can draw her Christian name, and there her writing skills stop.

This young woman was born with a cardiac failure. Five years old she was operated and had an artificial heart valve installed. At fourteen she underwent the same kind of surgery again.

Her body balance and body motorics are bad. Both feet point 45° outwards, just to name one of her problems with moving. She is squint-eyed.

This is 2009-03-20:
I don’t believe there is any hearing on the right ear at all. But the UCL for the right and left ear are so close on 4 kHz, that the right ear anyway might possess its own uncomfortable level. The audiogram does not leave room for a test of recruitment.

She doesn’t protest as I gradually turn up the resonator to full volume. But after a few minutes she gives up. The sound makes her very tired. But she lets me play a Volf Acoustic Record from the low register (801) on the Lyrec without complaining. The school also is asked to let her consult chiropractic.

She doesn’t really want this treatment. It’s boring, she says. Her teacher’s message is that it is plain to see that she has been treated. 2009-06-12 she has received a total of eight treatments:

She now writes two of her three names. She looks less squint-eyed –
at least this day. I test recruitment up to 80 dB at 3 kHz. There is none to find. Hence she might not have any hearing function on right ear at all. Subjectively the young woman is easier to educate than she was before and behave much better than she did.

**Number 9**

He is fifteen. The school can’t educate him. When they try, he goes berserk. He is impossible to have in a classroom. His literary abilities are alternating. Sometimes he reads well. Sometimes “the letters just revolve,” he says. When asked to write his name, he does so and goes on writing his full address and birth data as well. He bites his nails. His lordosis curves far too much. The muscles around it are very tight.

2010-03-02 we make an audiogram:

I ask the school to have him sent to chiropractic parallel to the treatment with sound.

He hears the Icelandic Mezzoforte. He has no problem with the volume of sound from the resonator. Nor with the volume of Volf’s sound in headphones.

The chiropractor gave him a few sessions, which gave him relief. After five treatments in all with sound both school and family report a remarkable improvement of his behavior. Time is up for testing again. Date is 2010-04-10:
Now limits of UCL do not show on the audiometer anymore. We finish the treatment with Volf Acoustic Records from the higher register (802, 189, 190 and 611). Until end October he receives nine more treatments. They are not concluded in a final test. Subjectively the young mans mother tells how happy she is, how well her son has developed. Objectively he has stopped biting his nails.

Number 10

He is sixteen. Can’t read, write or spell. When asked, he is able to write his Christian name, and that’s it. His thoughts races uncontrollable, he says. He suffers from problems with sleeping.

2010-05-12 his hearing is tested:
There is not much to say about the treatment. He starts at a relatively high volume. The first time it has to be reduced a bit, but after that his ability to take greater volumes develops gradually. He gets eleven treatments before we test him again. Unfortunately that happens to be on a day where he has smoked hashish. A fact that makes the outcome doubtful.

2010-11-09:

Subjectively the teacher reports great advances. Objectively he now writes his full name. He gets five more treatments and stop.

Number 11

He is not quite fifteen yet. He can draw his Christian name and nothing else. The school that sends him to Ordbindeklinikken, is his fourth. He is a heavy cigarette smoker and a heavy hashish smoker. He walks uncontrollably. Both feet points out.

The date is 2010-06-03:
The first session with Volf Acoustic Records makes him very tired. After the next two, improvements in his ability to attend school education are reported. After his fourth session, which takes place in August after summer holidays, we don’t see him anymore.

Number 12

He looks twenty some, but is fifteen. Reads and writes ok, but his temper makes it difficult to have him in a class. He is over sensitive to sound. He feels harassed by mischievous spirits. He is intolerant to dairy products. He obviously doesn’t believe in washing. He frequently smokes cigarettes as well as hashish.

Date is 2010-04-27:
Not much of an acoustic window. Left ear is almost short-circuited.

During four sessions in May he tolerates more and more on the resonator until he reaches full level, and a relatively high level in the headphones with Volf’s sound. The therapy tires him, which I consider to be a good sign when it is at the beginning.

Over the next half year he receives all in all fourteen more treatments lasting less than half an hour each. In October it is reported that he neither uses tobacco nor hashish anymore. And some of the mischievous spirits he felt before, have left him.

When we finally test it happens to be on a day where a close friend of him just died. The day is 2010-12-14:

[Graph showing hearing levels]

The sudden diminishing of hearing at 6- and 8 kHz – especially on the right ear – shows, according to my experience, a situation of stress. If we had tested a third time after a month or a week, the diminishing would probably have disappeared.

The late Poul Erik Lyregaard, who was the driving force behind the establishment of Oticon’s Eriksholm Research Center, explained at one time to me how it is more or less impossible to get a reliable audiometer test of hearing at 6 kHz. The reason being irreconcilability between the impedances of the headphone capsule and the ear canal. It’s well known that taking off the headphones of the audiometer and putting them back on often gives another result at 6 kHz. What we can do at 6 kHz is measuring the hearing dynamics.

On 2010-04-27 they were 40 dB in the right ear and 45 in the left. Now they are 70 and 75 dB. An increase of 30 dB on both ears. Hearing mainly has opened up in the high register of 4 to 8 kHz.
Number 13

She is eighteen. Mentally she in some ways is a girl of thirteen. In short periods she is more mature.

Contrary to the youngsters formerly described, she is highly extrovert, where they are highly introvert people. She laughs and talks and cries a couple of breathtakes and then laughs again. She tries to listen to answers, but she can’t comprehend what people say. The amount of words she has in stock is limited. She is constantly on guard towards what is said about her, and since she doesn’t comprehend, she is vulnerable and perceives everything in the worst way. Even when she is laughing, her defences are up – even when there is nothing or nobody she needs to defend herself against.

She has been institutionalized in a psychiatric ward. Afterwards – the last two years – she has been prescribed Quetiapine – an atypical antipsychotic approved for the treatment of schizophrenia – in relatively high dosage.

She writes her full name without problems.

She used to take dance lessons. Now her left knee hurts so much that she had to give it up. She is over sensible to sound.

The audiogram 2010-10-28 looks like this:

This young woman has a language. It’s fast and the endings of words are by no means spoken clearly, but a language it is. And when I talk low right before her face and with eye contact, she also sooner or later understands what is said. (More often later than sooner). Her sense perception does not function well at all, to put it mildly.

On the resonator we hear Metallica. The volume is under that which the meter can measure, but it is most likely around 50 dB. From
the Nagra she gets the Volf Acoustic Record 348 in headphones at around 50 dB too. It makes her laugh hysterically, she moves and turns on the chair, she has difficulties with breathing, and she has tears in her eyes.

Some days later she hears solo cello suites by Bach at less than 60 dB. The 348 on the Nagra is some 15 dB louder than it was first. Next week she hears the violin concert by Sibelius at 80 dB on the resonator, and Volf Acoustic Record 187 at more than 65 but less than 75 dB in headphones.

So her hearing is opening up. Next time she comes, she tells how she feels her movement. Walking and standing are much different from before. Her left knee is no problem anymore. Suddenly she finds herself able to flex her toes and move them separately too. An ability she always wanted to have.

After all in all seven treatments we test again. 2011-01-11:

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Right

Left

She still has difficulties with her – many – relationships with boys, problems with adapting to the school, she feels bad about the way she behaves, and she has over-sensible eyesight, has two visions at a time, and is herself aware that she can’t really read in the light from neon tubes or low energy light bulbs. But in general she is regarded as functioning much better than before. And she feels happy!

The school and her mother debate whether or not she can stop her intake of Quetiapine. Her mother tells me that it was tried before with absolutely no success. But now they plan to try again in connection with the young woman being moved to another school and institution.

After a pause from acoustic therapy she returns. 2011-05-30 her audiogram looks like this:
- Which is more or less the same hearing dynamics as was found in her second test. The hearing loss on 6 kHz left ear is gone now.

The Acoustic Window revisited

Audiometer test of the range of hearing dynamics is a fast and non-expensive test.

What youngsters with letter-diagnosis like APD, ADHD, Asperger and autism concerns, it is relevant and advisable to test their hearing tolerance or hearing dynamics. It’s a test that can show if their acoustic window is limited and suffers from a degree of sense-confusion – of hyperacusia – where the hearing sense and feeling senses are not sufficiently separated.

It can be our partner, our friends, our schoolmates, pupils, sisters or brothers, our patient – it may be ourselves – we are for a great part connected to each other through our acoustic windows. If that window is not open, or if the opening is too narrow, it limits the opportunity for communication between us.

It is when professionals encounter the behavior results of a more or less closed acoustic window that they attach the before named diagnostic letters and words, the meaning of which seems to be: “It’s they who are different or to blame. Not us!”

And the professionals are right. Even if the other senses such as sight and body smell and taste and tactile senses are part of the picture, intellectual contact and intellectual work is difficult or impossible without satisfactory connection through the acoustic windows involved.

Regarding the thirteen youngsters in this paper, it’s for a vital
part the missing abilities of their inner ear that is to blame for the problems they have with adapting to school, and the problems the school has with handling them.

**Treating low hearing dynamics**

Where children and youngsters are concerned, a session on the resonator lasts between eight and twenty minutes. Grown-ups may sit for an hour or more, if they want. Every time a person is treated, the volume of the music can be increased a notch or two compared to last time, until they reach the maximum.

In this way we provide the inner ear with some properties, it didn’t possess before.

Normally one of the Volf Acoustic Records is given in headphones afterwards. A record always lasts five minutes. Here too, the volume can be increased from one time to the next.

Every time we can increase volume in the headphones, we have provided the inner ear with some properties, it didn’t possess before.

For some people showing over sensitivity to sound, at first it will be impossible to use headphones. In such cases Volf’s sound should be played on the resonator at a volume, the person can tolerate. When the person treated has adapted himself or herself to the sound, it will be possible to change to the headphones.

The person treated should not be exposed to more than one Volf record (lasting five minutes) a day. Clinical experience tells us that playing a record twice on the same day, for some reason unknown to me, seems to cancel its effect.

In the tradition from Volf a treatment starts with records from the lowest registers: 187, 188, 348, and 801. Often one of these recordings will open the individual persons hearing more than the others do. It’s not possible to know which one will have this effect.

When a first re-test is scheduled, the 802 or 189, both representing a link to the recordings from the higher register, should be considered.

At Ordblindeklinaiken a new test takes place after the hearing has opened somewhat. The new audiometer test takes place a week or more after a prior treatment.

If we can see from the test that the recordings belonging to the lower end of the scale more or less have done their part, we may continue with the higher end recordings like 802, 189, 190 and 611. 803 belong to the absolute end phase of a cure and is relatively seldom used at Ordblindeklinaiken, and then mostly where grown up and elderly persons are concerned. We have to my recollection never used it on children.
Could other kinds of sound be used for opening a hearing sense?

After the time of Christian A. Volf (1894 – 1967), a number of therapies using sound have developed. Some filters the person’s own voice, some use sound from waves or whales or birds or White Noise – you name it. After the beginning of pc-era, computer generated sounds are used too.

Until now it has not been possible to determine whether or not these other therapies works as well as Volf Acoustic Records do. The reason being that no therapist using other acoustic therapies has tracked their effect on the hearing dynamic range, the way it can be measured using an audiometer.

Discussion of the effect of sound therapy on the thirteen youngsters here described

The aim with the acoustic therapy is to expand the opening of the acoustic window. An expansion may lead to side effects such as better conduct, the developing of literary skills and better psychic conditions as stated before. They are a bonus that occur so relatively often that it made it worthwhile for the school to send their more or less disturbed pupils to Ordblindeklinikken. Side effects often start showing after one, two or three single treatments.

A regular treatment for the lack of dynamic range of the auditory sense consists of coming to the clinic once a week for a treatment not exceeding half an hour. None of the pupils described in this paper came with such regular intervals for the necessary twelve to twenty treatments.

We also had to treat in spite of medication with antipsychotics or central stimulating drugs, not to name for example hashish. To what degree the treatment with sound is helped or inhibited by these factors is unknown.

About number one – the thirteen and a half year old boy – nothing objective can be said as he, while the cure lasted, changed from being medicated with the central stimulating Ritalin to medication with the antipsychotic Abilify. His hearing dynamic range as measured on the audiometer opened – yes – but it might as well be the change in medication that did it.

He started reading. That is an effect that Volf Acoustic Records seem to possess. At least when scientifically investigated by the
Danish department of Education in 1961-62. Abilify is not reported to have similar effects on literary abilities, but the possibility that it has, should not be overlooked.

When a person with a very low range of hearing dynamic is taken into therapy; it is from a therapeutic point of view in the hope that the hearing dynamics as tested on the audiometer can be expanded. This was successfully done with number 2, number 7, number 8, number 12 and number 13. To a minor degree it was done with number 3.

Number 9 is a special case. From the beginning he has the largest acoustic window of them all. In fact his first test – before treatment – is better than any of the others after they have been treated. But he acts just as sense-confused as if his audiometer tested hearing had been collapsed. His first measured THR-to-UCL range is 85 dB (at 4 kHz, left ear.) As the ideal range is over 120-, he is short of more than 35 dB. His acoustic window is reduced with a factor of between ten and hundred times related to, what is considered normal. After treatment the sound from the audiometer does not hit any uncomfortable limit in his ear. His acoustic window has increased more than 35 dB. The personnel at his school consider the effect on his ability to take part in school education as very good.

A case like this number 9 educates me. I learn from it that I can’t look at an audiogram only and say: “Compared to the twelve other pupils this persons hearing function doesn’t look bad at all.” Number 9 had a bad functioning hearing and a bad functioning acoustic window; independent of that his audiometer test showed a much less significant loss of hearing dynamics.

Number 5 showed no increasing of hearing dynamics on the audiometer, following the therapy. Anyway he, as well as the school, experienced his temper calming down to a degree where he and the school could work together. He could now end up getting an education after all, which was considered impossible before.

We don’t know all the properties of the inner ear. By treating his hearing some functions that are not measured on the audiometer can very well have improved. It might also be that he believes the therapy to have an effect and therefore reacts positively towards it. Placebo effects take place with physiological therapies as well as with any other therapy.

It’s difficult to say anything objectively what concerns number 10. He had smoked hashish on the day of the second test, and nothing

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is known about the effect of hashish on THR and UCL. 

With regards to number 4, 6 and 11, their treatment was dismissed before a second test could be made.

Subjectively it is reported from the school that all of the thirteen showed better conduct in school after their treatment had started. For number 1 unfortunately only for a period.

The inner ear and the skeleton

I have a theory that to some degree is visible here and there in this paper without being specifically identified. My theory is that the inner ear suffers when skeletal functions are unstable.

The inner ear is the centre not only for hearing, but for equilibrium as well. Our scientific understanding of the inner ear is that it contains two separate organs. The two organs share one of the three lymph’s of the inner ear, namely the Perilymph. The perilymph in other words connects them, making them maybe not so independent after all.

The inner ear of man has the same physical dimensions as the inner ear of a domestic cat. I believe that the cat’s organ of equilibrium makes it unproblematic for the animal to maintain body balance while walking on four legs, and that it can provide the cat with an excellent hearing sense when compared to man. Since man has a bigger body and furthermore walks upright on two legs, the organ is possibly insufficient for fulfilling its purpose.

My theory is that the task of maintaining the body balance for man under ideal conditions reaches the limit of the capacity of our organ of equilibrium. As part of my theory is the often overlooked existence of a mutual dependency between the skeletal functions on one side and the organ of equilibrium on the other. If the organ of equilibrium does not function perfectly, skeletal functions suffer likewise. And vice versa.

In the phrase “the skeletal functions” I include the systems of muscles and their tonus as well.

When the capacities of hearing functions are increased, it is not the hearing organ alone that profits, but the inner ear in total. When the properties of the inner ear is opened, muscle and skeletal functions are likewise improved. Like number 13; the girl who suddenly was able to flex and move her toes individually after her acoustic window had expanded some.

Likewise I believe there may be a connection between the congenital heart failure of Number 8 and the deafness of her right ear.

Could it be that the thirteen youngsters mentioned in this paper are born with unstable skeletal functions that from the beginning
exhausted the capacities of their inner ear?

This is very likely the case. Every one of the thirteen fulfilled the Beighton’s test for hyper mobility.\(^3\) Hyper mobility often gives raise to unstable skeletal functions.

This theory is founded on more than thirty years of clinical work. It might be true or it might be false, but it does work in daily clinical praxis.

Conclusion

All of the youngsters sent from the special school showed diminished dynamic range of audiometer-tested hearing compared to what is considered normal.

But what is normal?

We can’t know if a diminished dynamic range of hearing is normal, because the population as such has never been examined for their audiometer tested hearing dynamics. Scientifically it is therefore not possible to conclude that diminished or even totally short circuited or collapsed hearing should be considered abnormal or give rise to a distorted sense of perception that again might develop for instance conduct disorder. I have a theory that it often does, but my theory is only derived from logic. It is not based on scientific proof.

Likewise I shall not conclude from this small group that youngsters showing different kinds of conduct disorder will show diminished or short-circuited hearing dynamic range. I can only safely say that for the thirteen youngsters that their teacher chose to send to Ordblindeklinikken, it clearly was the case.

But I may be allowed to conclude that in some cases, the training of the inner ear seemingly leads to better conduct order and in many of the cases also to a greater span of hearing dynamics as tested on the audiometer.

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\(^3\) The Beighton score is measured by adding 1 point for each of the following:

- Placing flat hands on the floor with straight legs
- Left knee bending backward
- Right knee bending backward
- Left elbow bending backward
- Right elbow bending backward
- Left thumb touching the forearm
- Right thumb touching the forearm
- Left little finger bending backwards past 90 degrees
- Right little finger bending backwards past 90 degrees

A score of more than 4 points fulfil the syndrome.
I may be allowed to suggest that acoustic therapy, better conduct and greater span of the acoustic window, as I prefer to name it, are phenomenons that are coupled to each other.

I find it under all circumstances logic to conclude that the limitations of The acoustic Window, that all of the thirteen youngsters, who wee sent from the special school, suffered from, made them people who in general had to suppress contact with acoustic information. Especially indoor where reflections and echoes make it difficult or impossible for them to distinguish speech. When they came to Ordblindeklinikken, they did not possess a hearing that told them: “Listen!” On the contrary. Their hearing told them: “Don’t listen! Just try to survive the uncomfortability or pain of sound.”

Children and youngsters with this problem – hyperacousia – sometimes show a very noisy behaviour, seemingly in strong contrast to their over-sensitive hearing sense. I have found that they do so in order to dominate the sounds in their environment themselves. Their indoor life is spent trying to avoid hearing others.

This being the case: Suffering from hyperacousia, their relationship to a school can seldom live up to a normal schools expectations.
Appendix
Volf Acoustic Records

In his lifetime (1894-1967) Chr. A. Volf was treated as an outsider by the academic world. The members of the academic world would not for the life of them touch neither his resonator, nor his acoustic records. (There were exceptions. The psychiatrist professor Erik Strömgren (1909-1993) did not reject the possibility of treating his patients on the Statshospitalet I Risskov with the Volf Acoustic Records. The pediatrist Svend Heinild (1907-1994) respected Volf very much, he once told me).

Very few total collections of his Volf Acoustic Records remain. And a 78-record is a fragile thing. However they represent something that should not be lost to mankind. This also goes for Volf’s resonator.

Christian A. Volf was a Danish-American working with hearing aids in the nineteen twenty’s and -thirty’s. He claims he represented the firm Siemens & Halske. He therefore became acquainted with the Harvey H. Fletcher’s sound, which is well known within the hearing aid industry that uses its characteristic curves to test hearing apparatus.

Fletcher’s sound is made from a mixture of frequencies with equal difference. It might be 700, 800, 900 and 1,000 Hz. The result is a distorted tone with the frequency of 100 Hz. This sound has the special property that if it is heard with one ear only, nothing happens. But heard in both ears, it may cause disturbances of equilibrium and body balance.

In his acoustic sounds Christian A. Volf seems to have tried to come as close to Fletcher’s sound as is possible using a musical instrument. The electronic engineer Jakob F. Gormsen establishes that the tones for instance can be:

\[ G^1, G^2, D^3, G^3, H^3, D^4, F^4, G^4 \]

The numbers refers to the octave. The differences in frequency makes the outcome almost Fletcher’s sound. But not quite. The differences between the tones will be:

392, 391, 393, 408, 374, 444 and 342 Hz.

The instrument used, modulates the tones. In fragments of a second

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4 Erik Strömgren: Indberetning af 17. maj 1956 til Direktoratet for Statens Sindssygehospitaler.
they slide whole, half and quart tones. Gormsen has computer-generated a simplified picture of what happens:

The picture is a spectrogram showing a spectrum with duration of a little more than three seconds taken from the Volf Acoustic Record 187.

The first 0.6 seconds of the sequence is divided in five equal parts. First part starts at ground note E$^1$. 329 cycles per second. It goes down to ground note D# (D-sharp) at 311 cycles per second. Every part begins 20 cycles under the previous part. After 0.6 seconds the next sequence starts.

The bottom line is the tone made by the – unknown – musical instrument. The nine lines over it are harmonics made by the resonance tubes of Volf’s big resonator that – according to what Volf himself told – was used as studio during the recording, so the 510 resonance tubes in the resonator could contribute to the sound. Volf always kept the information about how he developed the sounds on these acoustic records a secret.

The nine Volf Acoustic Records

They were given numbers instead of names. The numbers are not related to the contents of the recording. They are three last digits in their RCA-register number. Each recording lasts five minutes, give and take up to ten seconds.

Six of the recordings refer to different octaves on the grand piano. On these six recordings the octave on the piano that the recording refer to, is played before the acoustic sound begins.
Volf recorded three “extras” outside this system. Two of them he later transferred to an ep-record, which was used for the treatments of hearing of the thirteen literary handicapped children in the successful pilot-experiment in Fredericia that took place under The Department of Education.⁶

Description of the six system-recordings

The following six recordings refer to each their full octaves on the normal piano. The tones of the fragmented sub-octave going from E to B, generally found on a piano, are not used.

Volf tried to sell his acoustic records to audiologists treating people with hearing loss. The idea being that the audiologist should choose the record from the octave where the hearing loss was found and sell it to the patient. The patient should then to go home and play the record for herself or himself using headphones.

I doubt if he ever was able to have any audiologist buy the records. And if they did – if any patient would go home and do as instructed.

Instead Volf treated a number of patients himself and sold his records this way.

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This is a snapshot of the sound of the 187 as it looks when frequency analyzed. The central peak of the spectre rising over the 60 dB mark is a 468 Hz-tone. The rest of the range stretching a little over 20 kHz is a mixture of harmonics and ordinary noise from the surface of the record. Near the end of the recording there is a sequence consisting of a broad range of hammering sounds.

The piano octave starting the recording is C, D, E, F, G, giving the octave from 64 to 128 Hz. The first whole octave on an ordinary piano.

In the Volf tradition, 187 might naturally start any series of treatment, either played in headphones or – when headphones are not possible to use – played on the resonator.

187 was published on cd in High Fidelity 3/97, Copenhagen: Forlaget audio media as, Reference cd no. 25.
The dominating peak, being the deepest tone of the recording, is 118 Hz. The dominating register goes on to around 3,4 kHz. The rest is harmonics and background sound.

The piano-accord starting the acoustic sound is the second accord on the piano. It goes from 128 to 256 Hz. 188 is seldom used. Only if a sense of hearing is painfully oversensitive, it can be relevant, as it is perceived as the “mildest” recording of the set.
The dominating peaks are found in the domain from 69 Hz to 3.3 kHz. The piano accord gives the third octave from 256 to 512 Hz.

Subjectively 802 sound energetic and eager. If we were to choose one – and only one – record of the nine, this would be a candidate.
The piano accord on this recording is the fourth octave on the piano, ranging from 512 to 1024 Hz.

In the sound of the recording, the range from 425 to 3776 Hz is dominating.

I use 189 as a stepping stone when I move from groundwork-treatment to the middle or final treatment.
And this is octave number five. It’s dominating tone-spectre reach from around 1400 to 4200 Hz. The accord at the beginning of the recording is the octave: 1024 to 2048 Hz.

The recording is clear and brilliant. The recording is technically good. Therapeutically it gives very good results near the end of a treatment.
Finally the sixth octave. From 2048- to 4096 Hz. The frequencies surpassing 30 dB range from around 1600 to around 4000 Hz.

I use the 803 as the very last record after a longer series of treatments of grown ups. Youngsters seldom hear it. It is never used on minors.
The three “extra” recordings outside the system
The frequencies of this recording range from around 40 to 1200 Hz. This recording goes down in the octave from sub-E to sub-B. The piano sequence in the beginning gives four accords starting with 32 Hz and ending with 512.

In some cases 801 has been shown to be the most powerful of the whole set. Indeed so powerful that in some cases its effect on hearing and equilibrium was much too strong for the person treated.

The recording ends with sounds of hammering.
This is a universally usable recording with emphasis on the middle registers. The dominating peak reaching over 60 dB, is 454 Hz. There are harmonics at 2458 and 3397 Hz. There is no piano accord at the beginning. Towards the end of the recording there is the sound of hammering.

348 was transferred to an ep – extended play recording, 45 rpm, the so-called dyslexia record – designed for and used for the acoustic treatment of the school children who joined the successful pilot-experiment in Fredericia that took place under The Department of Education.\(^7\)

\(^7\) C. Buch-Sørensen et. al: **Behandling af ”ordblindhed” med Chr.A. Volf’s metode.** København: Ugeskrift for Læger 124/35, s. 1295 ff.
This too is without piano accords. In the frequency range it spans from 2235 to 3000 Hz. It was used on the ep-record made for the pilot-experiment in Fredericia together with 348. The quality of the recording on the ep-record is technically problematic, but the record work anyway.
Resumé
Det akustiske vindue

En lærer på en efterskole for unge der er så stærkt adfærdsforstyrrede at ingen normal skole kan håndtere dem, sendte tretten af sine elever til Ordblindeklinikken i det håb at akustisk terapi kunne sætte dem i stand til at udvikle boglige færdigheder som læsning og skrivning. Dette fandt sted fra 2008 til 2011.

Ved audiometertest viste hver eneste af de tretten hyperacusis i form af lav høretolerance eller høredynamik. I visse tilfælde syntes de unge slet ikke at have nogen:

"U"-ernes centrum angiver den lydstyrke hvor tonen fremkalder ubehag, kilden i trommehinden eller smerte.

I visse tilfælde viste høretærsklen sig stærkt forvrænget:
Den hyperacusis som hos de tretten kommer til udtryk som nedsat høredynamik og/eller stærkt forvrænget hørekurve, synes i hvert enkelt tilfælde at være fuldt ud tilstrækkelig til at forklare den uhensigtsmæssige adfærd, de lagde for dagen.


I alle tretten tilfælde oplevede skolen subjektive forbedringer af de unges adfærd i tidsmæssigt sammenfald med behandlingerne på Ordblindeklinikken.

Nogle af de unge udviklede læsefærdighed. Noget som ikke havde været inden for mulighedernes rækkevidde før. Forbedringer af læseevnen betragtes her som sideeffekter ved eller bivirkninger af den akustiske terapi.

Adfærdsforstyrrelser og boglige handicap udtrykker mangelfuld fungerende sanseopfattelse. I de fleste tilfælde synes forstyrrelserne af sanseopfattelsen at være Hyperacusis.

Audiometertest af høredynamikken kan føre til en bedre forståelse af børn og unge med adfærdsforstyrrelser, ligesom det kan blive til hjælp for både skolen og for den unge selv, når den unge får adgang til terapi, der kan medvirke til at forbedre den akustiske forbindelse med omverdenen. Samt at drage nytte af de sideeffekter eller bivirkninger som akustisk terapi synes at få.