
Environmental sound enrichment

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Tinnitus and misophonia often emerge in quiet places. The auditory system evolved in the presence of continuous nature sound. Silence is unnatural and associated with danger and evokes a warning response. Environmental sound enrichment is required 24 hours a day with non-stimulating sounds that are pleasant, and never result in an aversive reaction. They are required in all of the Jastreboff diagnostic categories, whether instruments are worn or not.

Those patients with wearable sound generators should use environmental sound enrichment whenever they are without their instruments, particularly at night. When instruments are worn, they provide all the sound enrichment that is needed. The prescription of instruments by the professional is dependent on the TRT diagnostic category (0-4), and some patients do not need them.

Modern sound environments versus nature

In nature, there is a continuous background of nature sounds. Silence is a warning signal, usually indicating the arrival of a predator. In modern society, we have constructed solid buildings, which exclude sound, and are often double-glazed to reduce heat-loss. This means that the rooms we live and work in can have very low levels of natural background noise, particularly at night.

In many countries, especially in the west, there is a tendency for smaller social units, with more people, particularly older people, living alone in very quiet surroundings. The ready availability of earplugs means that they are often used, not just to protect the ear from damage, but also to avoid hearing any sounds, particularly at night. With an increasing number of older people in our populations, there are many more with varying degrees of hearing loss. Proper use of hearing aids is far below what is needed, and this has the effect of imposing a 'relative silence'.

One feature of our western culture is the way in which silence is imposed in childhood. We are told to be quiet when we go to bed / do your homework etc. It is during these times that childhood tinnitus and misophonia emerges, as well as the development of behavioural patterns for seeking silence in adult life. We even have the saying 'Silence is golden;' - it is NOT!

Effects of reduced environmental sound

The Heller and Berman (quiet room) experiment tells us that tinnitus emergence (the first experience of tinnitus) is experienced by anyone who listens carefully in a quiet room for 5 minutes. Most of us do this every night of our life when we retire to a quiet study, lounge or bedroom. It is perhaps surprising that we can do this for so many years without having any experience of tinnitus. Animal experiments have shown us that the auditory system itself increases in sensitivity when background noise drops below a certain level, resulting in increased gain, or amplification, of external sounds. This is the mechanism of hyperacusis. This means that there is more chance of picking up very weak sounds (e.g. predators!) in silence, rather than in enriched environments. When these sounds come from normal nerve cell activity in the brain, tinnitus emerges.

Loudness of any sound depends on the contrast between the signal and any background noise. Consider listening to a car radio on the motorway, with the volume up at a comfortable listening level, and then driving off into a quiet side road, or garage. The radio can then cause loudness discomfort in a normal listener. In silence, the loudness of even quiet sounds may be perceived as very loud, particularly if they have strong meaning (e.g. a burglar alarm at night 200 metres down the street). For the same reason tinnitus will sound very loud if there is no sound enrichment. When in silence, the attentional focus of the auditory system can only be directed to the one sound (e.g. tinnitus). There is no possibility of not hearing it.

Changes in the auditory system can only occur if it is being stimulated with sound. These changes are necessary for the habituation (or blocking) of intrusive external sounds and tinnitus. Plasticity (the ability to change / reprogramme) is reduced by silence. Reduced stimulation of nerve connections concerned with gain or

amplification, and also with the aversive reaction to sound, results in habituation being slowed down significantly.

These effects continue during sleep. The cortex is in a low state of activity in sleep, so we have no conscious awareness of ourselves, or our environment. However, at this time, subconscious pathways and auditory filters needed for selective hearing, function normally. The failure to enrich our sound environment during sleep means the effectiveness of sound stimulation in increasing plasticity, is reduced by at least one third.

Reasons for seeking silence

There are many reasons why we have a natural tendency to seek silence. Many people try to avoid 'territorial intrusion', perhaps because of the dislike of an unwanted, unannounced visitors, or telephone call, or the sounds of a potentially violent city. The concept is; no sound means no intrusion. However the quieter it becomes, the more easily we can hear softer and further-away sounds, which simply demands the need for greater protection from these sounds. Silence may be considered by many to be peaceful and relaxing, but in fact, our autonomic nervous system activity actually increases, getting us ready for the possibility of predator attack! The best environment for relaxation is one enriched by nature sounds.

It is common to develop quite strong views about what is acceptable in terms of other people making noise. Decreased tolerance for sound is often considered normal behaviour. However the neighbour's television set is much more likely to be unpleasant if you already dislike the neighbour, than if the set belongs to a much loved family member with a slight hearing impairment! The dislike for ordinary everyday sounds is much commoner in patients with tinnitus, and indeed 40% have pre-existing sound sensitivity. It is always important to question your own views about other people's noise, rather than to assume that all noise production is a malicious attempt to cause you discomfort.

Normality of environmental sound enrichment

The art of sound enrichment is very old and found in many ancient civilizations, most notably perhaps in Japan. Here, waterfalls, fountains and wind chimes have always been a part of architecture and landscaping. A very important job in Japan is that of the waterfall tuner.

Most people find that the sounds of nature are enjoyable and relaxing. Being in the garden or on the beach is, for most people, a relaxing experience, although climate plays a large part in whether this is feasible or not. Even tinnitus and hyperacusis patients find these place peaceful, and often report that tinnitus disappears completely, e.g. when on holiday. The sound of rain, and even wind, can be soothing and calming, and generally is not intrusive in the way that man-made sounds may be.

Part of the reason for this is that our hearing system developed in a sound-rich environment, with nature sounds ever present, and it is adapted to this type of sound background. It is only over the last few hundred years that buildings have effectively excluded these sounds. Modern architecture is one very important cause of the present increase of tinnitus and hyperacusis.

Sleep is a problem for many people. Sound enrichment improves sleep quality in everyone, and it for this reason that devices simulating the sounds of nature, or CDs with recordings of nature sounds, are being sold widely for this purpose. These devices are used mostly by people without tinnitus or sound sensitivity, but are particularly useful, and recommended by us whenever TRT is performed.

Types of sound enrichment

Perhaps the best natural sound enrichment is nature itself. For country-dwellers, it may be possible to have the window open all the time. Where security and bad weather make this impossible, it is important to create sounds inside the home where we spend the majority of our time. In the past household equipment has been recommended as a simple available sound source, e.g. large domestic fans or ceiling fans, fish tanks, etc. Where these sounds are a

normal part of the home environment, they can be helpful, but the volume is not easy to control, and tinnitus may be masked by them (contraindicated in TRT). Water features are excellent; indoor as well as outdoor Japanese-style fountains and waterfalls are widely available. The sounds of water are particularly liked and well tolerated, even by misophonic patients (those disliking external sound).

Radios, TV and music should be used only when they are part of normal recreation, when you normally would listen to them. Just leaving these devices on all the time as sound enrichment is not recommended. All music and speech has meaning, and stimulate the autonomic system, at a time when we are trying to reduce reactivity. However, FM radio, tuned just off a station, produces a pleasant and controllable source of 'wide band noise', which contains a spectrum of many frequencies, and is quite constant. The use of HiFi amplifiers and speakers for presenting any sound enrichment ensures good quality realistic sounds, which will be more acceptable.

We recommend all our patients to purchase purpose-made free field sound generators, which have a selection of nature sounds electronically reproduced. These devices are much easier to control, to move about, or even to take away on trips. The better ones have good speakers, which sound great, and have a socket for connecting to a HiFi, or sound pillow speaker. Some of them have slot-in sound cards so you can collect a library of additional sounds. CDs and tapes of nature sounds are useful, but the content may vary and change, making them attention seeking. One sounds-of-the-sea tape we heard has rather strident seagulls! They may also be difficult to automatically replay. All sound enrichment should be continuous and not just used for a short period (e.g. getting off to sleep).

If wearable sound generators are prescribed as part of your TRT programme, there is no need for sound enrichment while they are being worn. However it is essential to use sound enrichment at all times when the instruments are not used, e.g. during sleep.

Features and requirements of sound enrichment

Sound enrichment should not suppress tinnitus (make it inaudible); habituation cannot occur to a sound you cannot hear. When you first turn on your sound source check that you can still hear your tinnitus, and that it hasn't altered or changed.

Naturally, the sounds must be audible. If you have a hearing loss then test them with your hearing aids turned to their normal listening setting.

It is essential that any sound enrichment never produces any aversion, dislike or results in increased arousal. The purpose of TRT is to reduce the aversive reaction to tinnitus or external sound. Introducing a new sound into the environment, which produces an aversive reaction, will simply make matters worse. It may take some time and experimentation to find the sound that you like, and that produces a relaxed feeling. It is also important that the partner/family should also find the sounds pleasant and non-intrusive. Usually this is not a problem, as family members realize the importance of this part of treatment, and understand that sound enrichment is good for everyone. Those with strong phobic reactions to sounds, or tinnitus, may need to introduce sound enrichment slowly, beginning with very low levels of sound which are barely audible.

Sound enrichment should be used 24 hours a day, particularly at night. Not using sound enrichment at night reduces the effectiveness of treatment by at least one third (the time you are asleep!). Because the parts of the hearing mechanism that are important in TRT are 'awake' during sleep, sound enrichment should always be used at this time. The new sound may seem intrusive at the time when you are trying to get to sleep, when you have been used to silence. It is a good idea to leave the sound enrichment source on at all times in the bedroom, so that it becomes a part of the "bedroom furniture". For those who have a hearing impairment, and if is a partner who cannot tolerate the sound enrichment, a pillow speaker can be very valuable.

Sound enrichment cannot be expected to produce lasting changes to tinnitus or misophonia on its own. For permanent

habituation to occur, sound enrichment must be used as part of a full TRT programme. Sound enrichment is an essential part of any TRT programme, regardless of the diagnostic category, or whether instruments are being used or not. It should be continued indefinitely, as it is beneficial for everyone whether they have a problem with tinnitus or external sounds, or not. In those who have been under treatment, it is an additional insurance that tinnitus will not re-emerge, and external sounds will not become troublesome again. However, after the end of a successful TRT programme it will be quite possible to experience complete silence without any bad effects from tinnitus or external sounds, although these may well be audible (Heller and Bergman).

Use of sound enrichment in a TRT programme

If you are working with a professional, preferably in a TRT programme, it is important that they interact with you properly over the use of sound enrichment. A good sound environment history should be taken, to establish how much natural sound is present in your environment at different times of the day. A good explanation is given of why sound enrichment is required, to stress that this is an important part of the ongoing treatment, and not just being used for symptom relief. Your professional should ensure that you have a good knowledge and understanding of the Jastreboff neurophysiological model, as this is the most essential part of any TRT programme. You may need some help, or suggestions about how to find the best enrichment sounds that will suit you. Ask for advice about how to plan the use of these, and their gradual increase so that they are present on a 24-hour basis.

If you have been using earplugs because of sounds sensitivity, the use of these should gradually be reduced, with sound enrichment taking the place of the earplugs. Most patients with sound sensitivity also require wearable sound generators, and the use of these, combined with environmental sound enrichment needs to be carefully planned by a trained TRT therapist. If you are anxious about abandoning earplugs, which you have been using in the past, be reassured that proper environmental sound enrichment will help this process and make it much easier. Any change

in practice should be gradual and not sudden, particularly if sensitivity to external sounds is extreme. Never do anything that makes your reaction worse!

The benefits of sound enrichment

A few of our patients are unable to obtain wearable sound generators, or there is persistent poor tolerance to wearing them. In patients where instruments are indicated by the diagnostic category as being important, sound enrichment can help as a substitute. However, it should be realized that TRT is not being applied optimally, and progress will be slower.

Many patients experience an immediate reduction in tinnitus intrusiveness and severity with sound enrichment, although this is a very individual response. Soon there should be improved sleep and reduced wakefulness. Environmental sounds will be less intrusive. If tinnitus has become intermittent rather than continuous, there is less likelihood of subsequent tinnitus emergence because of the absence of silence. Sound enrichment produces an overall reduction in activity in the autonomic nervous system. Autonomic levels are raised in all those who are having aversive reactions to tinnitus or external sounds, and sound enrichment helps to reduce overall reactivity. It also reduces the contrast of unpleasant sounds, or tinnitus, to background sound and therefore reduces their loudness. There is a decrease in abnormal auditory gain or amplification in the central auditory pathways, which directly counteracts hyperacusis.

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