

## **Tinnitus Treatment Guide**

### **Purpose of this Guide**

This guide is not intended to be a replacement for appropriate counseling and medical advice. If you have recently developed Tinnitus and have not already sought medical advice from your GP or ENT consultant you should do so as soon as possible. The information in this pack is intended to give you a reasonable background on the condition both to begin your rehabilitation and to help you ask informed questions regarding your treatment.

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### **Introduction to Tinnitus**

The loose definition of Tinnitus is ‘an hallucination of sound without external origin’. More formally McFadden (1982) said that ‘Tinnitus is the conscious expression of a sound that originates in an involuntary manner in the head of its owner, or may appear to him to do so’.

There are many different sources of Tinnitus sounds within the head, the most common being normal background activity within the nerves of hearing passing up to the brain. Sounds can also be generated by the jaw, blood flow and spasm of the muscles of the middle ear. In a small number of cases the ENT Consultant may be able to offer a direct treatment for Tinnitus, more usually Tinnitus

counseling is required. It is very rare for Tinnitus to be a sign of a more sinister condition.

When the Tinnitus signal first emerges it can be extremely worrying and distressing. The distress can be compounded further by negative counseling such as 'there's nothing that can be done' or 'you'll just have to live with it'. This fear and anxiety can often lead to a crescendo of the Tinnitus both in terms of its volume and its duration. Hallam (1984) recognized that the natural history of Tinnitus is one of 'habituation', i.e. no matter how abnormal and important the noise initially becomes over time this importance diminishes as normal life and its demands reassert themselves.

Our understanding of why we have begun to hear Tinnitus can have a profound effect on our reaction to the noise and to what degree we experience suffering related to Tinnitus. If we are engaged in a noisy job then occasional ringing in the ears is likely to be a normal experience shared by all your colleagues making its emergence less threatening. Similarly if we attend a noisy concert or disco it is a common experience for our ears to ring for some hours or even days after the exposure. Whilst it may be annoying we are unlikely to experience a great deal of fear or anxiety regarding the Tinnitus as we are quite clear on why we have it. It is often the case however that when Tinnitus emerges unexpectedly, or changes from a low background level to a louder more intrusive pitch that we can experience a strong fear response to the signal. When the brain detects a signal which it perceives to be a potential threat not only is it reluctant to filter it out but actually has systems to tune *in* to the threatening signal to allow it to be closely monitored. In the case of the hearing system it is interesting to note that there are actually more nerve fibers leading from the brain down to the ear than there are fibers going from the ear to the brain. The brain is therefore able to exert significant control over which sounds are deemed important enough to be passed on to the conscious mind and which sounds are safe to ignore and filter out. The brain has to be able to decide quickly from moment to moment which sounds are useful to us and which are safe to ignore, this process is known as *filtering*.

Why do we hear Tinnitus? In most cases the source of the noise is an activity in the body which has always been present, either random firing of the nerve of hearing or the pulse of blood through our veins. What can change either slowly or more rapidly is the degree to which we are capable of filtering these sounds out. One way this can happen is through developing a hearing loss, the brain attempts to compensate for the change by *reducing* the strength of its filters at the region of the hearing loss making us more likely to detect the small background activity in the body. Another common experience is changes in our levels of stress.

The stress response in the human has evolved to maximize our chances of survival in any threatening or challenging situation. There are many mechanisms involved with this from release of hormones like adrenaline, changes in blood flow towards the muscles, slowing of digestion and speeding up of heart and breathing rate. Additionally the brain turns *off* its filters for all background activity from all the senses, enabling us to detect and react to information which we may not normally be aware of but which may aid survival. This system works

wonderfully for real life threats but is not so helpful for long-term stress or stress relating to other life events. In the case of Tinnitus not only can it enable us to detect the signal, or perceive it as louder, it can also lead to us having a more negative and fearful response to it. Stress can take many forms and sometimes may be hard to spot, but some examples are; significant change in life e.g. retirement or redundancy, health problems, bereavement, increasing workload. One helpful way to visualize this is the Jerkes-Dodson Human Performance Curve. This shows us that while some stress in our lives can be positive helping us to achieve our goals, as stress increases its effects can be increasingly harmful.

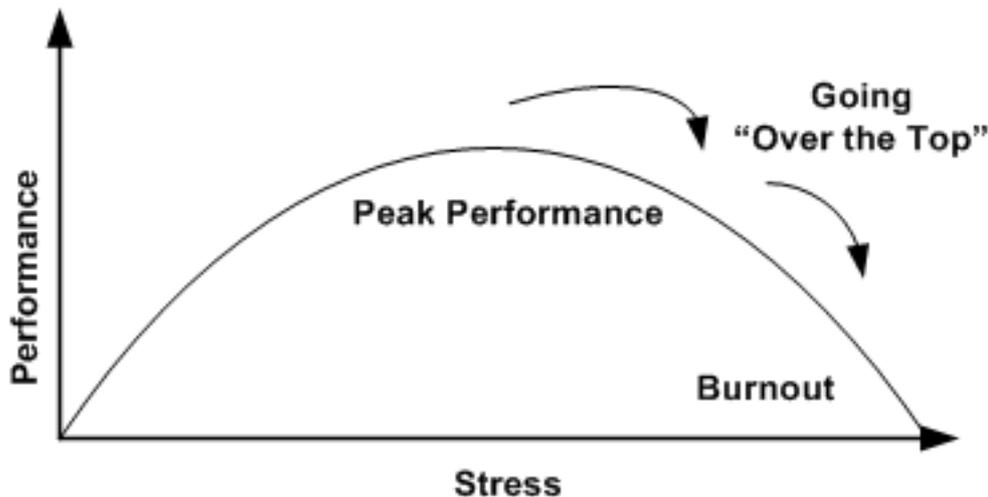


Figure 1 Jerkes-Dodson Human Performance Curve

The current model for Tinnitus 'suffering' is that it comes from a trapped fear response. Our initial fears, worries and anxieties about the noise we're hearing encourage the brain to monitor and focus on the signal and because of its internal nature and our apparent lack of control over it the brain does not get the opportunity to reappraise the threat over time and 'habituate' the signal as it normally would.

## **Tinnitus Management**

Tinnitus management as the title suggests is not offering a sure-fire way to 'cure' Tinnitus. In fact in medicine there are very few 'cures' for anything. Most interventions apart from surgery aim to manage or limit conditions while the body gets on with healing itself. One definition of a cure is 'a period of remission from a condition', and this neatly describes the goal of Tinnitus management. We aim to change your experience of Tinnitus over time such that it should become less intrusive, less persistent and sleep should improve. The overall purpose behind each intervention is to strengthen the auditory filters to reduce awareness and from this allow the brain to reappraise the importance and threat of the signal.

Within this pack there are exercises for changing your thoughts about Tinnitus, reducing or controlling your stress levels and reducing the impact of Tinnitus through the use of sound. It is important to recognize that the emphasis for each intervention will be different for everyone, i.e. some people may find relaxation is the most effective, others changes to their thinking and so on. Try in the early stages of your rehabilitation to engage with all three areas to find which ones help you the most. The evidence in this area usually suggests that changes to one's thinking about the Tinnitus can bring the greatest benefits.

A useful metaphor is that of Physiotherapy. If you break a limb and it rests in plaster for a long time when the plaster is removed the limb is likely to be weakened. The Physiotherapist will give you exercises to strengthen your limb. Should you choose to engage with the exercises fully your limb should regain its strength and function rapidly. If you choose not to engage it may take a good deal longer to recover and may never achieve full strength and function without further effort.

This is largely true in the case of Tinnitus in that there is a period of concerted effort required to stimulate the habituation process. Once begun we usually expect to see 'habituation of reaction' before 'habituation of perception'. That is the degree to which we experience suffering and distress from the Tinnitus becomes less over time. Once distress is reduced the brain begins to change its response to Tinnitus from one of 'fearful monitoring' to calm neutrality, encouraging the Tinnitus signal to be treated as 'safe' rather than as a threat. This change in meaning encourages more filtering *out* of the noise, usually first noticed as small gaps in perception. Of course as soon as you choose to listen for



it the sound will still be present, but the expectation is that both the length of the gaps should increase and the amount of distress experienced reduce over time.

Habituation of Tinnitus usually takes place over three to six months arriving at a point where Tinnitus is effectively managed. By this we mean that the impact on your life is significantly reduced and the amount of time you spend thinking about it far less than before. Complete remission of symptoms is rare and should not be anticipated as a goal of this treatment. As well as this it should be noted that subsequent life events such as further loss of hearing, periods of stress or illness may provoke a return of symptoms. In most cases provided you are careful to interpret this as a temporary increase caused by the event, and re-apply the management exercises it should return to it's previous levels within a short period of time. If symptoms persist further support may be required from your Hearing Therapist, Audiologist or ENT surgeon.

### **The Hearing System**

We are of course dealing with the hearing system when we have Tinnitus so it is useful to look at how sounds are normally heard. As we can see in figure 1 the external ear acts like a funnel, directing sound waves in the ear canal and towards the ear drum. Sound waves are actually vibrations of the particles in the air. When these vibrations arrive at the eardrum it vibrates in sympathy, causing the three small bones known as ossicles to move. The ossicles are hinged in such a way as to act like a lever with the last in the chain having a much smaller area to 'pump' the sound into the inner ear (or Cochlear) which amplifies the incoming sound wave.

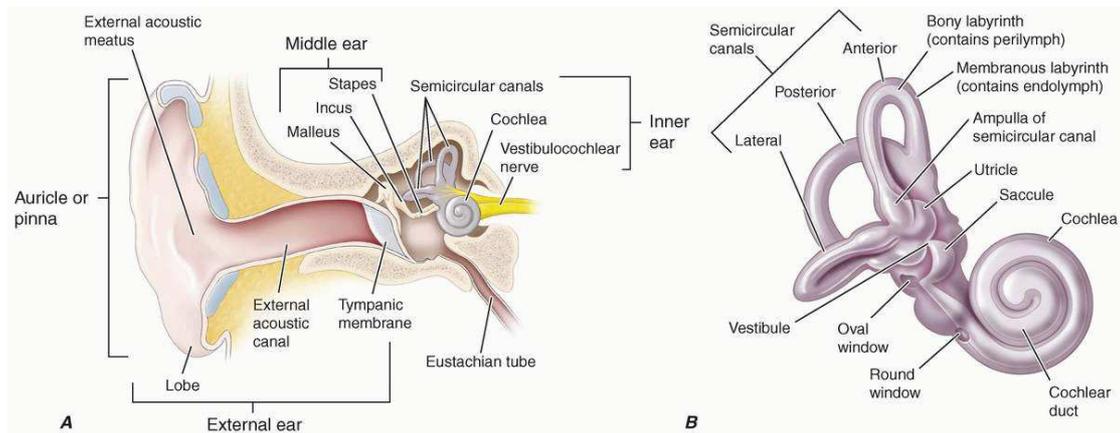


Figure 2 - Structures of the Ear

Once the sound wave enters the inner ear its energy is converted from movement into pulses of electrical activity by the stimulation of thousands of 'hair cells' arranged in pitch order from high at the outer part of the coil through to low pitch further down towards the centre. These pulses of activity are sent up the nerve of hearing towards the brain.

It is these electrical pulses that we hear as sounds, music, speech etc. around us. We are surrounded constantly with noise of one sort or another, loud or quiet from either natural or man-made sources. The role of the brain is to work out which sounds have meaning and which are meaningless and should be filtered out.

We learn to filter out or filter in sounds based on our prior experience of them and their meaning to us. A neighbour playing music loud at night may be upsetting, but if you are invited to their party the music may be pleasant. More significantly our hearing system has evolved to respond very differently to sounds which are perceived as threatening, actively filtering such sounds in to the conscious mind and amplifying their volume. Unless we are given the opportunity to re-appraise our interpretation of the sound as a threat the brain will not begin to filter the noise out of our conscious mind.

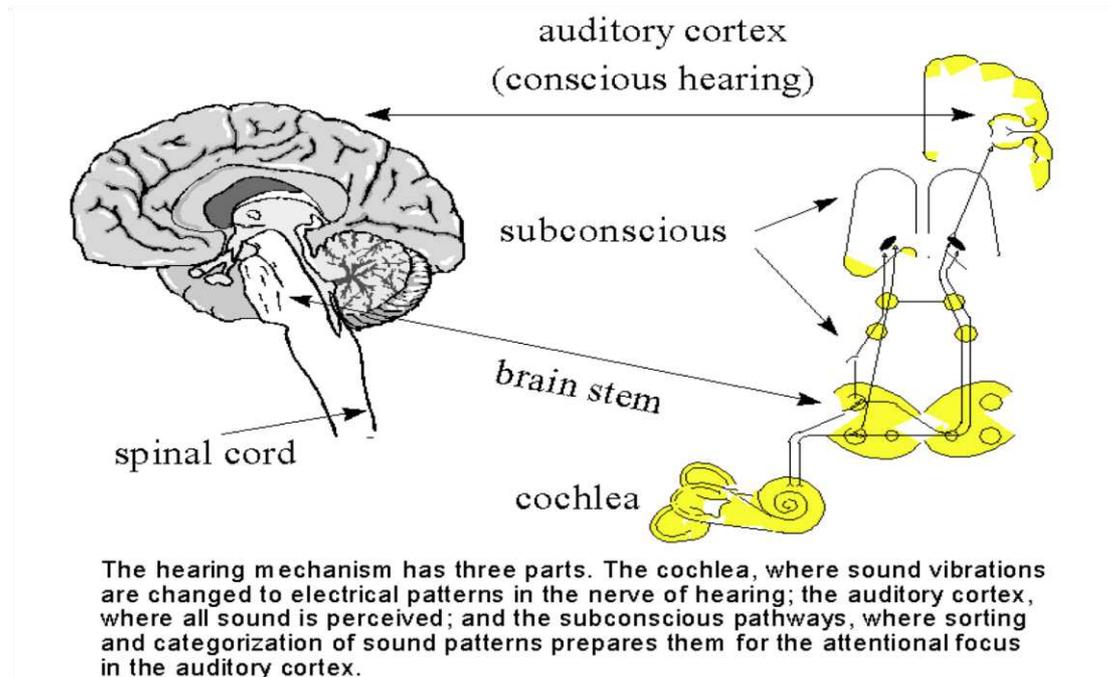
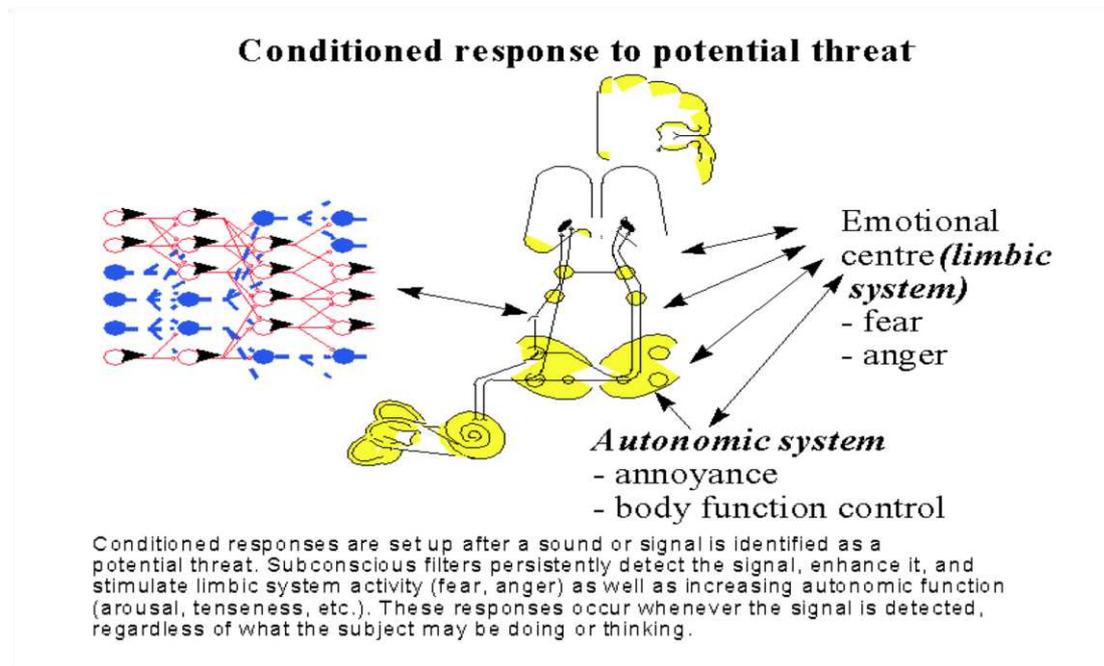


Figure 3 Auditory Pathway ©Jonathan Hazel

The diagram of the auditory pathway seen in figure 2 shows where the filtering takes place. Crucially sounds passing up the auditory pathway are only heard by us when they enter the conscious mind, in particular the auditory cortex. Anything which is filtered out before this level has been appraised by the subconscious filters as both safe and unimportant. As stated earlier the strength of the filters can change dramatically depending on external factors such as stress and illness.

In figure three we can see this interaction between filter strength, the stress response (autonomic system) and emotional state. Note the interrelated nature of all three elements. This is what used to be known as the 'vicious cycle' of Tinnitus in that we would hear the noise, become upset and experience stress which would in turn make the perceived noise become louder.



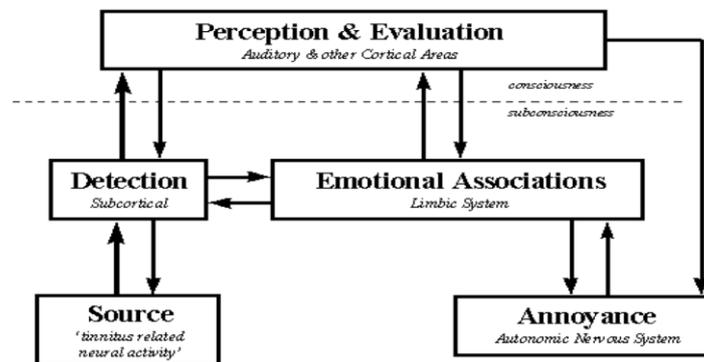
**Figure 4 Conditioned Response ©Jonathan Hazel**

In the late 1980's a neuroscientist called Pavel Jastreboff created the model seen in figure four. This model has been updated over the years with more emphasis now being placed on the 'upper loop' of perception and evaluation in the conscious mind.

What Jastreboff gave us was a working model of the dynamic nature of Tinnitus which helped to explain some of the more perplexing and upsetting aspects of Tinnitus. The model shows that any sound we hear is first detected in our subconscious mind. Our earlier experiences with that sound help to decide whether or not it is passed on to our conscious mind and actually heard, or filtered out. As we said above the auditory system is tuned to have a fight or flight response to unpleasant or threatening sounds. If a sound in our environment has not been heard before the first response of the brain is to treat the sound as a threat. It is safer from a survival point of view to assume something is a threat and then work out later it is safe than the other way around.

The result of this automatic instinctual reaction is that when we first begin to hear our Tinnitus we tend to have very strong negative thoughts about it. We may worry that we have a serious disease, tumor or mental illness. As can be seen in the model these strong thoughts will feed directly into our emotional and stress centers. When our stress levels and emotions are high our detection of signals becomes stronger (as the filters weaken) making the perceived volume of the Tinnitus louder. If however we are able to change our automatic fearful thoughts in relation to the Tinnitus we should be able to arrive at a point where the detection of Tinnitus goes down allowing it to be filtered out more often. This is in fact what we see happening in most cases. Instead of a gradual reduction in

the volume over time we start to see gaps in our awareness as the signal is treated as less important by our nervous system.



**The Jastreboff neurophysiological model of tinnitus**

The source of tinnitus perception may be any electrically active neurones in the auditory system. Detection filters in the subconscious tune to this signal on the basis of its (negative) significance. A conditioned response is set up (below the dotted line). The unpleasantness of tinnitus is solely the result of limbic system and autonomic system stimulation *outside* the auditory system. Simple detection of neuronal activity (as in disco tinnitus, or the Heller and Bergm an experiment) is very common, and of no consequence. In persistent tinnitus, limbic and autonomic activity continues until the aversive conditioned response is retrained, or re-learned.

Figure 5 Jastreboff Model of Tinnitus ©Pavel Jastreboff

This process takes place over time because of the hierarchical nature of the information the brain processes. By this we mean that the brain has a list of importance, for example from 'head is on fire' down to 'what colour of socks am I wearing?'. Somewhere on this list is the filtering point, below which the brain is filtering out information that is recognized to be of lesser importance for the time being. If we did not have this filtering system we would rapidly become overwhelmed by the range of signals assailing our senses. It takes a surprising amount of self-discipline and control to teach the brain to react in a different way to a signal which has previously caused distress, and this process takes some time to happen.

Crucially we are able to change the strength of our filtering point through managing stress and becoming skillful at relaxation. The more relaxed we are the stronger our filters for background signals become. If we are also able to cultivate a calmer, more neutral emotional response to the Tinnitus over time its stored meaning will change to a safer less important that is easier to filter. So it follows that when the stored meaning of Tinnitus (in terms of its importance)

falls below our filtering point we will experience a gap in our awareness of the Tinnitus. What seemed to be a constant signal changes to an intermittent one which causes less distress over time.

Because this *is* a filtering process the Tinnitus is largely either filtered out or filtered in. So when you have gaps in your awareness in most cases your Tinnitus will be completely absent from your thoughts. You will notice from the example chart below that in general it is true to say that the perceived volume of the Tinnitus changes very little over time (although you may experience some large short-term variation). Rather the gaps in your awareness get more frequent and longer lasting.

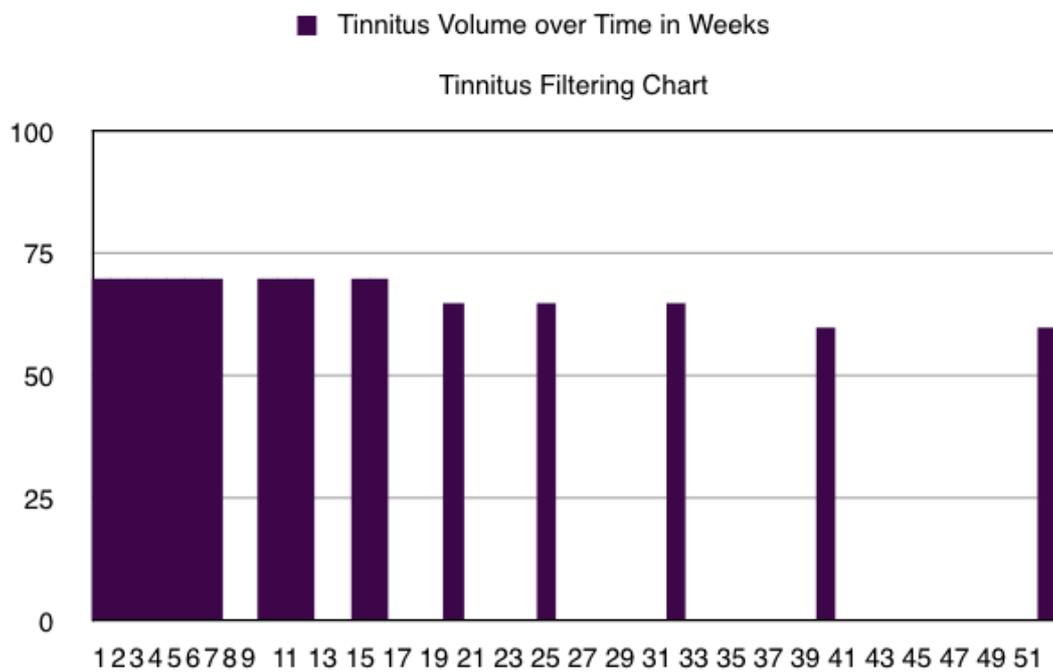


Figure 6 Tinnitus Filtering Chart

### The Dynamic Model

Below is a diagram that attempts to show the dynamic interactions taking place in the brain in response to Tinnitus and changes in our emotional state.

- There is a source of sound which may be in the middle ear, inner ear or higher up in the brain
- This sound is detected in the brainstem
- Memory centers in the subconscious (Diencephalon) are checked to see if this noise needs an immediate reaction
- The sound arrives at the conscious part of the brain which 'hears' it
- Conscious brain checks the meaning in the memory centers
- If there is NO stored meaning a signal is sent to the emotional center in the brainstem – making us more stressed and alert
- If there IS a stored meaning which indicates sound is familiar and safe then it may be automatically filtered, e.g. sound of a carriage clock or fish tank in living room
- If we have been distressed by this noise before, or the noise is one we feel is a threat, e.g. breaking glass at night, then the sound will be actively filtered in by the brain
- When our stress levels increase for any reason our central filters become weaker, which may make Tinnitus seem louder
- Should hearing levels change rapidly, e.g. cold or wax, this can cause the same effect as the brain tries to bring the hearing levels back into balance

Because of all these different factors it can sometimes be difficult for us to understand why our Tinnitus has suddenly started up, or changed in volume. It is usually an interaction between how important a threat your subconscious mind believes the Tinnitus to be, our current state of stress or relaxation and the ambient noise levels.

For example, you may find that your Tinnitus comes on or changes volume when you want to relax in front of the television. What's happening here? If your Tinnitus is still quite new or has recently flared up your brain is unable to try to ignore it and will selectively turn it up if it thinks the Tinnitus is the most important signal around you at the moment. This demonstrates that your brain

still considers the Tinnitus signal a threat or a danger. It's a little like trying to ignore a rabid dog in order to have a conversation about the weather, your brain will try to make you prioritise your safety.

Sleep is another time when Tinnitus levels can seem to act in an odd way. Although we are relaxing in preparation for sleep the Tinnitus can seem to spike just when we want it to be at its quietest. Why is this? Usually it is because we have moved from an environment where our brains are being bathed in high levels of background noise to an area of low noise, so the Tinnitus stands out. Additionally our brains may have been kept busy processing the information around us but when the level of stimulation drops below a critical level the Tinnitus may be the most important signal around for the brain to attend to.

The above are obviously only two of the possible examples of how are Tinnitus can fluctuate, variations in stress or emotion can also have a big impact as previously discussed. It is important to try to explain to yourself what is going on when your Tinnitus fluctuates like this. If you can understand *why* it is happening you are likely to feel safer and more in control of your situation and this will reduce any associated distress from the Tinnitus.

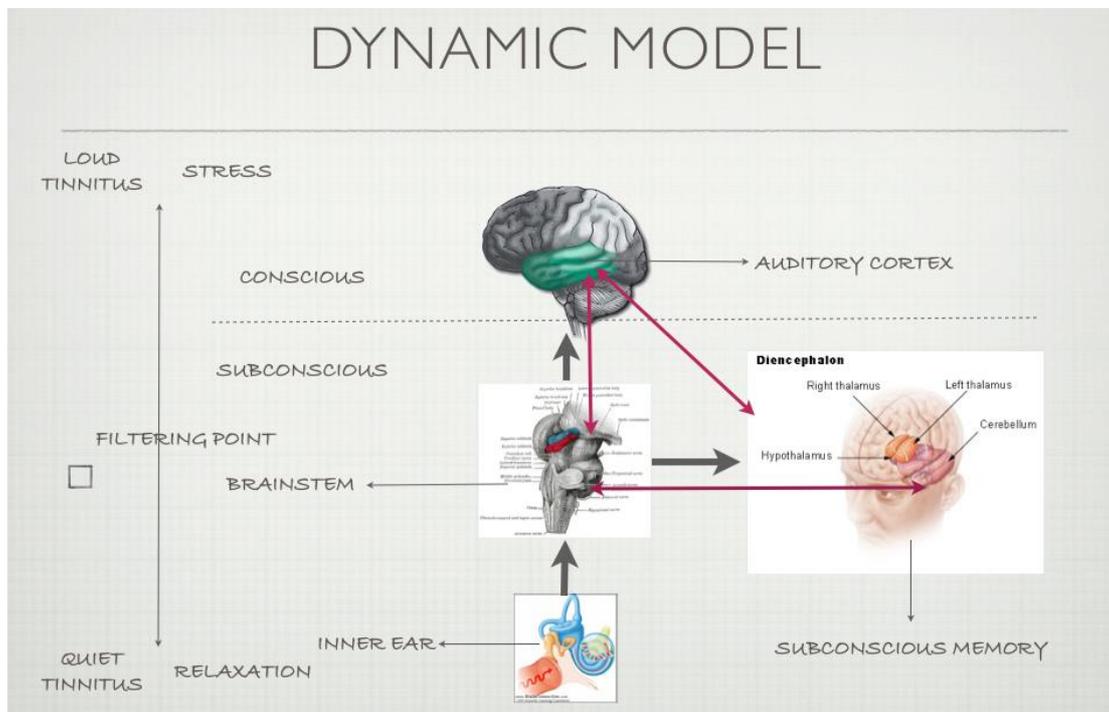


Figure 7 Dynamic Model of Tinnitus ©Tim Husband

## **Tinnitus Management Exercises**

### **Breathing Exercises**

Sitting in a non-stressed and relaxed posture with your arms by your sides and both feet flat on the floor or lying in bed:

Breathe in through the nose, hold briefly and breathe out slowly through the mouth counting how long each breath takes.

Try to take a little longer on the out breath each time until you feel calm and relaxed. Don't force the air out, just concentrate on breathing in a deep and relaxed manner. With each out breath allow yourself to rest more heavily in your chair or on your bed.

Make sure that your lower abdomen is pushing outwards with each in-breath, don't push out your upper chest or the sides of your ribcage.

Repeat three times daily if possible for between five and ten minutes.

### **Thinking Exercise.**

The idea here is to consistently prompt your subconscious memory to replace the learned fearful negative association in relation to Tinnitus with a more calm neutral reaction.

Do this once per day for ONLY 15-20 seconds in the early stages or when you are particularly aware of or distressed by your tinnitus.

In a quiet room listen to your tinnitus and say to yourself

- 1) It's my inner ear noises
- 2) They're perfectly safe
- 3) Perfectly healthy
- 4) They've always been there
- 5) My brain is capable of filtering them out

It may not change your experience there and then if you are having a bad time but cumulatively your brain will learn to filter the Tinnitus out more often than filtering it in.

### Sound Enrichment

Use a table top sound generator or other neutral sound source all the time at a comfortable volume in your bedroom. Tabletop sound generators offer a range of continuous natural sounds such as waterfall, seashore, woods etc. Set the volume just below the level of your tinnitus. Try to find a sound you feel is pleasant and relaxing.

This will buffer the transition from wakeful activity downstairs to an otherwise quiet bedroom. It can also help you get back off to sleep if you wake in the night, and help you to have a more relaxed waking period in the morning. You can also use the sound ball/neutral sounds when enjoying other quiet activities such as reading, painting, sewing etc.

A good range of tabletop sound generators can be found at the British Tinnitus Association.

The British Tinnitus Association  
Ground Floor, Unit 5  
Acorn Business Park,  
Woodseats Close  
Sheffield, S8 0TB

0800 018 0527 free of charge

[info@tinnitus.org.uk](mailto:info@tinnitus.org.uk)

[www.tinnitus.org.uk](http://www.tinnitus.org.uk)



### Control Exercise

One of the most consistent complaints of patients with Tinnitus is their perceived lack of control over their experience. It can seem as though the Tinnitus is a random force which we can't interact with or change. Where we place our attention can make a significant change to how we hear sounds. If you



think of trying to hear the piccolo or double bass in detail when listening to a piece of music you will realize we can only hear one at a time clearly. The act of placing our attention on one makes us lose focus on the other sound. Performing this exercise can help you to feel more in control of your experience, and if we feel in control it is easier to interpret that experience as safe which helps us to filter the Tinnitus out.

While engaged in another listening task such as watching television, listening to music or your sound generator, change your focus of attention between the sound and your tinnitus. Notice the difference in the prominence of your tinnitus as your attention shifts from one to the other. Repeat this task three or four times in one go once per day in the early stages until you feel control is no longer an issue for you.

### Sleep Hygiene Method

Only use this if sleep is significantly delayed or disturbed. The idea is to help your body back into a natural and more reliable rhythm of sleep but this may take a few weeks so be patient. Once a reliable rhythm is established these rules can be relaxed as far as you deem prudent.

- 1) Only go to bed when you're tired and ready for sleep, not when you think you should
- 2) Don't do any other activities in bed (TV/Reading etc.)
- 3) Get up at the same time every morning, regardless of how poor the nights sleep has been
- 4) Get up and do a low-level activity if sleep doesn't come after about half an hour. Only go back to bed when you are feeling tired and ready to sleep
- 5) Try not to have a hot bath or hot drink just before going to bed

- 6) Don't have a snack or hot drink if you wake in the night
- 7) Don't nap during the day

### Relaxation

Managing your stress levels can be key to the management of your Tinnitus. There are a number of different techniques that can be helpful in lowering your levels of tensions and anxiety. These can be as simple as the slow breathing exercise above or as complex and in-depth as yoga. Massage can be very helpful in helping you to identify where you carry tension in your body and allowing you to experience a relaxed state. You may wish to try visualizations such as imagining yourself sunbathing on a beach or fishing by a river.

One of the more effective and straightforward techniques is that of Progressive, or Deep Muscle relaxation. In this you are guided to slow your breathing and gradually work through your body top to toe loosening and relaxing your muscles. The British Tinnitus Association have a very well produced CD that you may find helpful, it is available here: <http://www.tinnitus.org.uk/products/3>

It is worth noting that not everyone responds well to the same relaxation technique. You may need to try a number of different CD's or classes before you find something that works well for you.