The Neurophysiological Model of Tinnitus and Hyperacusis:

The Neurophysiological Model of Tinnitus was published in 1990 and developed by Pawel Jastreboff, Ph.D.\textsuperscript{1} This landmark model of tinnitus provides a frame of reference for understanding tinnitus, hyperacusis, and misophonia (dislike of sound), as well as the basis for a specific clinical approach to treating tinnitus. The main idea of this model is that a number of systems in the brain, in addition to the auditory system, are involved in the phenomenon of tinnitus.

In particular, the interactions between the auditory system, the autonomic nervous system, and the limbic system (the center of emotions) are crucially important in clinically significant tinnitus. The difference between people who merely experience tinnitus ("patients with tinnitus") and those who suffer because of it ("tinnitus patients") relates to these connections; that is, the level of annoyance is dictated by the interactivity of the limbic and autonomic nervous systems. Approximately 25 percent of patients presenting with tinnitus suffer from the more clinically severe level of annoyance.\textsuperscript{2}

This model has been proven to be successful for treating tinnitus based on the concept of habituation.\textsuperscript{3} It is the foundation of Tinnitus Retraining Therapy (TRT) and Neuromonics Tinnitus Treatment. Neuromonics was developed by Paul Davis, Ph.D. and the Neuromonics Corporation.

Habituation

Everyone habituates sound every moment of every day. Sound passes through the ear and up the brainstem to the auditory cortex of the brain. If a sound is new or novel, it will be heard and prioritized by the autonomic nervous system (ANS). If the ANS determines a sound to be meaningless or unimportant (e.g. a new refrigerator), it will no longer be heard or given attention. The sound will be habituated or filtered out. We cannot possibly be aware of all the sounds that we hear on a daily basis. This is the fundamental concept of habituation. This phenomenon explains what millions of people who are not bothered by their tinnitus do. They habituate their tinnitus and their ANS assigns it to be meaningless or unimportant.

For some individuals, their ANS determines that the tinnitus is something to be concerned about. This reaction involves the limbic system, the part of the brain which governs our emotions. When concern, stress, anxiety, or fear reactions are elicited, the tinnitus now has meaning and cannot be habituated. This keeps the tinnitus at a high level of perception because the ANS has determined this is a sound that needs to be monitored.
Tinnitus Retraining Therapy begins with habituation of the *reaction* to the trigger sound. The first phase of TRT focuses on changing this strong negative reaction to a reaction that is neutral. In the second phase, sound perception is habituated, i.e., sounds become less consciously monitored and less noticed. This type of habituation has similarities with methods used for treatment of chronic pain.

It is not possible to completely eliminate tinnitus, but it is possible to help change the reaction and perception of the tinnitus by manipulating the environment. The strength of the tinnitus can be decreased by adding sound to the environment. This is much like decreasing the brightness of candle flame by adding more light to a dark room. The physical characteristics of the candle flame do not change whether it is in a dark room or a room filled with light, but the perception of the brightness of the candle flame changes. This premise is applied to sound so that the tinnitus itself does not change, but the patient’s perception and reaction to them diminish when there is added environmental sound.

### 24 Hours a Day Sound

TRT protocol recommends sound 24 hours a day including during sleep. Research shows that our brains are actively processing our environment even while sleeping, so it is important to engage the brain during sleep so it is less aware of tinnitus. Generally, nature sounds or neutral sounds are most beneficial. Sound machines are an easy source of continuous sound.

### Tinnitus Retraining Therapy (TRT)

To achieve habituation and relief, specialized sound therapy devices are used in specific ways and in conjunction with TRT educational counseling. The devices include sound generators, combination hearing devices with sound generators, or table top devices. The actual timeline required depends on a variety of factors including the symptoms, compounding medical complications, choice of therapy, and the patient’s compliance with the treatment protocol. Over time, the use of the devices minimizes or discontinues in most cases. This process requires retraining the brain at a subconscious level. This demands time and patience. There is no “quick fix” however, significant benefit is achieved in over 80% of cases.

### Neuromonics Tinnitus Treatment

Neuromonics is an FDA approved Class IIA medical device for tinnitus with a specific individualized treatment program. It was founded in 2001. The Neuromonics device is always to be used with the specific treatment protocol. Relief and benefit usually occurs more immediately than with TRT. The basic treatment is typically completed in 6-8 months. Patients report immediate relief and find the treatment simple and pleasant. Our clinic incorporates some aspects of TRT with our Neuromonics protocol. Not all patients with tinnitus are candidates for Neuromonics. During the assessment there is the option to try a demo unit and determine Neuromonics treatment candidacy.
Treatment Considerations: TRT vs. Neuromonics vs. Masking

The Tinnitus and Hyperacusis Clinic uses all methods. This clinic considers Neuromonics Tinnitus Treatment to be similar to TRT in many ways. They are equally effective for certain symptom groups but not for others. Neuromonics is often faster to produce noticeable relief for those able to use it. However, not all types of patients and symptom patterns are appropriate for Neuromonics alone, notably those with complicated hyperacusis, misophonia and/or significant hearing impairment. Neuromonics and TRT may be used as a singular therapy or in strategic combination or with other disciplinary interventions. Masking is incorporated as one of several sound therapy components simultaneously operating within Phase 1 of Neuromonics Tinnitus Treatment. Masking is removed in Phase 2.

Masking is the temporary obscuring of tinnitus by another superimposed sound. However, once the obscuring sound is removed or reduced the tinnitus and its reactions typically return, and often at a more noticeable level. Masking can sometimes be used for temporary relief and in cases of low to moderate levels of disturbance. Sound generators used in TRT protocol are not maskers nor are they used as maskers.

What's Next?

Take time to review these main concepts and implement any of them that apply to your situation. You may have been given recommendations for things to do at home. You likely were also given specific recommendations for individualized treatment should you decide to proceed in that direction. Please let us know if we can help you further.

References