SIMILARITIES BETWEEN TINNITUS AND CHRONIC PAIN

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Severe tinnitus has many similarities with chronic neuropathic pain

We can learn about tinnitus from knowledge about chronic neuropathic pain:

- For getting better understanding of the pathology and causes of tinnitus
- For finding better treatments of tinnitus

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Severe tinnitus and chronic neuropathic pain

- No visible signs of illness
- No objective signs (imaging signs etc.)
- Tinnitus and pain are not life-threatening

Tinnitus and pain do not receive much sympathy from relatives, friends or health care professionals

BUT

- Tinnitus and pain affect the quality of life, causing **suffering** of many people
- Strong emotional components

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"The only tolerable pain is someone else's pain"

René Leriche, French surgeon, 1879–1955

One could say the same about tinnitus

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Likelihood of having tinnitus?

Almost always

- Vestibular Schwannoma
- Ménière's disease
- Trauma to the auditory nerve

High likelihood

- Old age
- Hearing loss
- Traumatic brain injury
- Blast injuries
- Exposure to impulsive noise
- Wilson's disease
- Down's syndrome

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Tinnitus has many different forms and different severity

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The sound of tinnitus may

- be just annoying
- be distracting
- make it difficult to do intellectual tasks



Zahra Akhavi, 2013

Severe tinnitus may affect an entire person, causing severe ***suffering***



Zahra Akhavi, 2013

Severe tinnitus may be similar to the Phantom Limb Syndrome:

Pain and tingling after amputations are felt to come from the body part that has been amputated

Conclusion:

The anatomical location of the pathology is the brain

Phantom Sensations



Severe tinnitus is a ***phantom sensation*** that is perceived as coming from the ear

Tinnitus may occur in people with severed hearing nerve

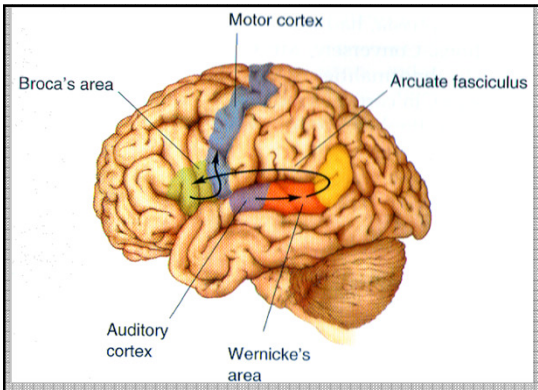
The anatomical location of the pathology is often the brain

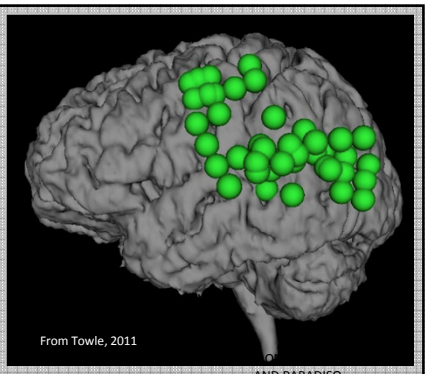


Modern view: Many parts of the brain are involved in common tasks

- Several parts of the brain are involved in most tasks
- Some parts of the brain can do more than one task
- Many parts of the brain interact with each other
- The mind can control many functions such as how muscles contract

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AND PARADISO

Production of speech and interpretation of spoken words were earlier believed to be done in only two parts of the brain

We know now that large parts of the brain are involved in interpretation of spoken words

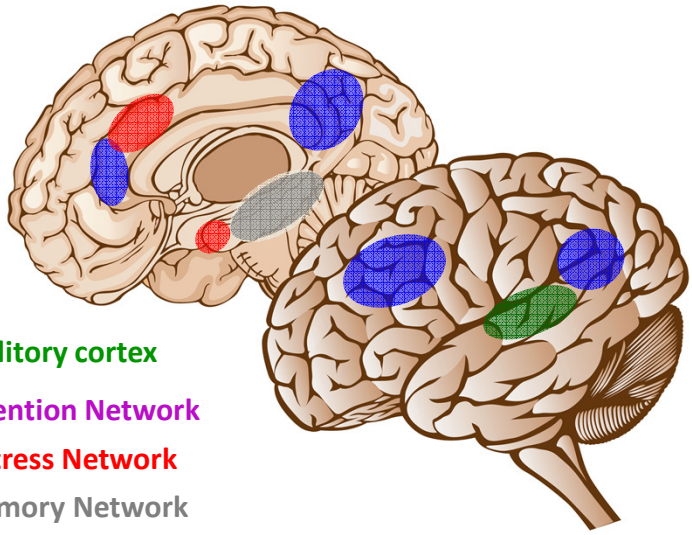
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Modern view: Symptoms of diseases do not come from just one part of the brain

Many forms of tinnitus are disorders of the brain that involves many parts of the brain

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Tinnitus, like severe pain, engages many parts of the brain



Auditory cortex

Attention Network

Distress Network

Memory Network

(From Schlee, 2009)

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Severe tinnitus and chronic neuropathic pain are ***Plasticity Disorders***

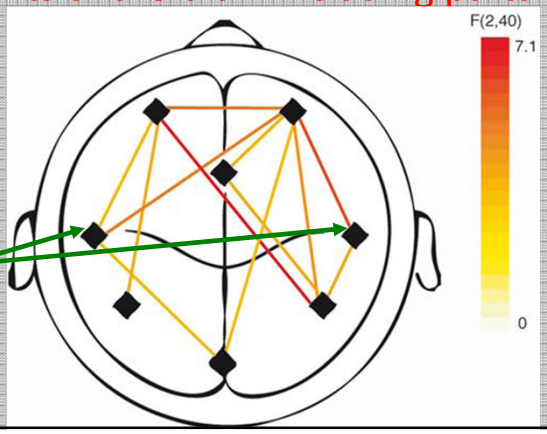
Maladaptive plasticity is involved in causing the symptoms and signs of severe tinnitus and chronic neuropathic pain causing:

1. Altered connections between different brain structures
2. Altered relationship between excitation and inhibition increasing the central gain
3. Dorsal and medial thalamus may be involved bypassing the primary cortices

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Studies using new techniques show how connections in the brain are altered in people with tinnitus

In people with tinnitus the auditory cortices are connected to parts of the brain including parts that are normally not involved in hearing



Auditory cortex

(From Schlee, 2009)

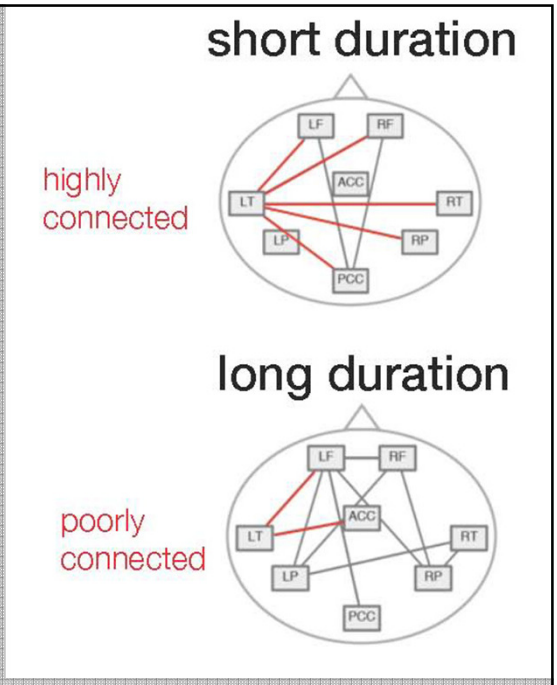
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Tinnitus:
Connections in the brain, changes over time

Short time:
Concentrated to the temporal part

Long time:
Widespread

LF = Left Frontal,
RF = Right Frontal,
LT = Left Temporal,
RT = Right Temporal,
LP = Left Parietal,
RP = Right Parietal,
ACC = Anterior Cingulate Cortex,
PCC = Posterior Cingulate Cortex



From Schlee et al 2009

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Treatment of tinnitus

- There are many forms of tinnitus
- A single treatment cannot treat all forms of tinnitus
  - How to find out which kind of tinnitus a person has?
  - How to find out which treatment is best

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Treatment of tinnitus and pain

- Medications
- Neuromodulation
- Behavioral therapy
- Treatment of underlying diseases

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Tinnitus is far more complex than earlier assumed

A multidisciplinary approach to treatment is necessary for success

- Better methods for diagnosis of tinnitus are necessary for successful treatment
- Understanding where it comes from (ear or brain) is important for development of new treatments for tinnitus
- ***It does not help to treat the ear when the problem is in the brain!***

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Recent Internet advertising

Picture text:
Get Rid of Tinnitus NOW

Do not trust everything you read on the Internet

Aim treatment at the location of the pathology!



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Different goals for treatment for tinnitus

- The tinnitus should be eliminated
- The tinnitus should be reduced to a level where it is less burdensome (management of tinnitus)
- Give the patients hope for success in the treatment
- Unfulfilled goals may cause disappointment and search for other health professionals who may promise full relief

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Tinnitus and chronic neuropathic pain have two parts:

- Tinnitus: (1) The sound the person hears and (2) the *effect* of tinnitus on the person (**suffering**)
- Pain: (1) The perception of pain and (2) the *effect* of chronic pain on a person **(suffering)**

WHICH ONE TO TREAT?

The strength of the tinnitus and the degree of suffering are not always related

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Aim of treatment of tinnitus:

Reduce the perception of the tinnitus
or
reduce the suffering on a person?

- The loudness of tinnitus is not directly related to the effect it has on a person
- Negative reactions to tinnitus
  - Afraid the symptoms are signs of a serious disease
  - Lowered tolerance to sounds (hyperacusis)
  - Prevent sleep and intellectual work

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Treatment of underlying disorders

- Temporomandibular joint (TMJ) disorders
- Neck problems
- Sinus problems
- Ear problems

(Lack of sound input to the brain from hearing loss)

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Neuromodulation

PAIN

- Transderm electric nerve stimulation "TENS"
- Electrical stimulation of
  - the dorsal column
  - the premotor cortex
  - the thalamus

TINNITUS

- Sound stimulation
  - Hearing aids, masking devices
- Electrical stimulation
  - of the ear
  - of the auditory cortex
  - the dorsal thalamus?
- Transcranial magnetic stimulation TMS

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Medications

PAIN

- Nonsteroidal antinflammatory drugs (NSAID)
- Opioids
- Antidepressants

TINNITUS

- Lidocaine
- Alprazolam
- Antidepressants?

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Sound treatment and counseling

- Tinnitus Retraining Therapy (TRT)

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Stimulation of the somatosensory system *can relieve tinnitus*

- Electrical stimulation of the ear or the skin behind the ears can relieve some forms of tinnitus
- Basis: Nerves from the skin around the ear make connections with cochlear nuclei

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Electrical stimulation of the *left* vagus nerve for treatment of:

- Epileptic seizures (Approved by FDA, 1997)
- Depression (Approved by FDA, 2005)
- Pain (Experimental)
- Tinnitus (Experimental)
- Obesity (Experimental)

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Acupuncture

(A form of neuromodulation)

Hypnosis

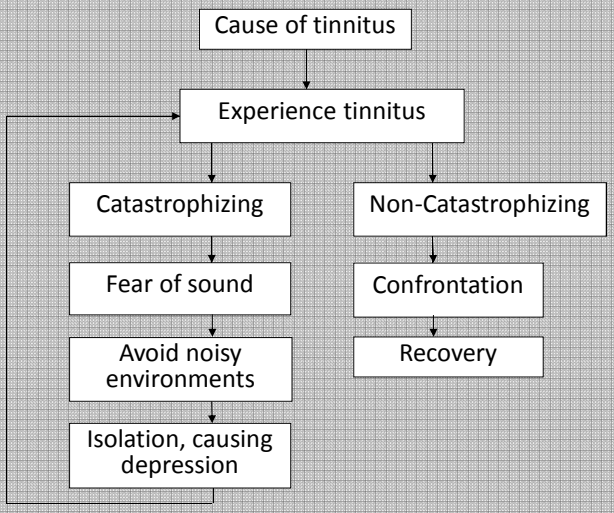
(A form of central control of tinnitus)

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Reversal of neural plasticity as treatment of plasticity disorders

- Electrical stimulation of the vagus nerve promotes plastic changes
- Electrical stimulation of the vagus nerve paired with sound stimulation is now being tried for treatment of tinnitus

A person's reaction to his/her tinnitus is important for the outcome of any treatment



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Catastrophizing

My tinnitus is bad today and it will probably be worse tomorrow.

Will I have tinnitus all my life? There is nothing that will help.



Zahra Akhavi, 2013

Non-catastrophizing

My tinnitus is bad today but it will be better tomorrow.

Confrontation:
I will do something for my tinnitus.

I will seek treatment, if it does not help, I will learn to cope with my tinnitus.



Coping

"*I HAVE TINNITUS BUT TINNITUS DOES NOT HAVE ME*"

Coping is a learned skill

- Different parts of the brain are activated for *active* and for *passive* coping

Evaluation of treatment

The patient's own evaluation is the most important measure of the results of treatments

Remember that tinnitus often has two parts:
The sound and the suffering

- Use of an analog scale for evaluation of the strength of the tinnitus sound
- Use of an analog scale for evaluation of the severity of suffering

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From where may progress in treatment of tinnitus come?

Multidisciplinary approach

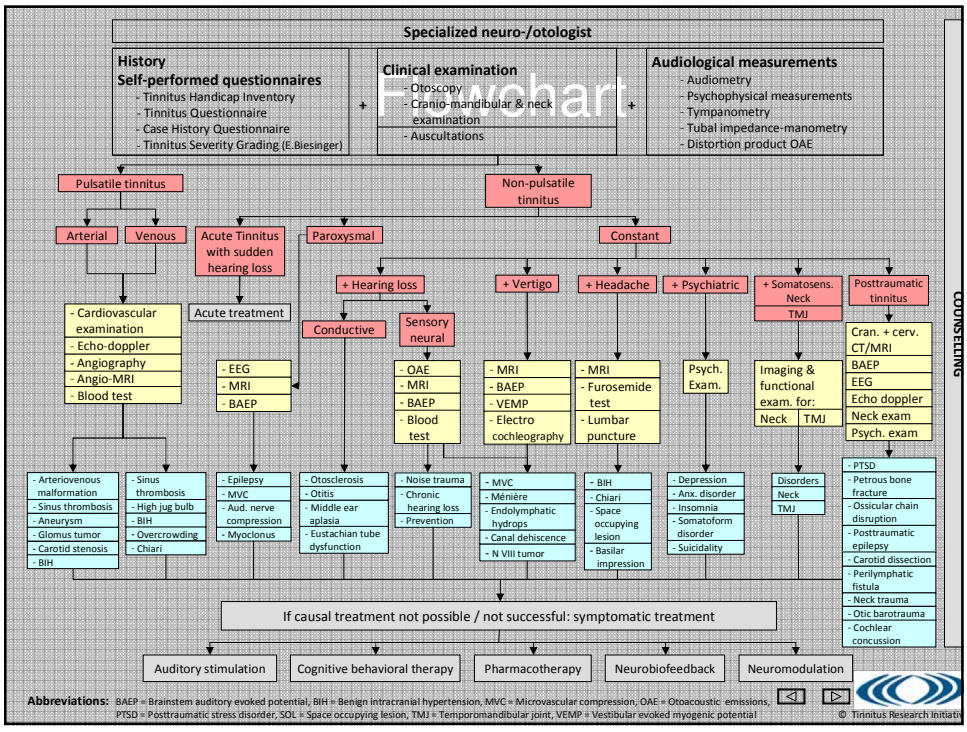
- Learning from other disorders such as *pain*
- Evaluate treatments based on their effects on the adverse effects (***suffering***)
- When testing of new treatments consider that treatment of tinnitus has large placebo effects

Set reasonable goals for treatment of the tinnitus patient (management vs cure)

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Recommendations by the Tinnitus Research Initiative

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THANK YOU

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