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## Theories of Hearing

Sarah Mae Sincero 19.5K reads

There are several theories that attempt to explain the perceptual processing of sound sensation. However, the most referred to hearing theories are the Place Theory and the Frequency Theory. These are two opposing theories that have been continuously developed until mid-20th century.

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## Place Theory

Also known as the Resonance Theory, this theory was proposed by Helmholtz in 1857. But, it is worthy to note that crude forms of the Place Theory had been created as early as 1605. Helmholtz' modern theory of hearing states that incoming sounds from the environment are, in a spectral representative form, extracted by the inner ear. The inner serves as a tuned resonator that passes the spectral representation to the brainstem, and then to the auditory cortex via the auditory nerve. The basilar membrane of the ear resonates the sound with a corresponding characteristic frequency or CF. For instance, if a sound stimulus has a tone of 300 Hz, the part of the basilar membrane that has a CF of 300 Hz would be stimulated. This process is also called frequency place-mapping.

Critics of the Place Theory of hearing argued that most often than not, characteristic frequencies are hard to determine below 120 Hz. Perception of sound stimuli accounting for low frequencies are associated with the frequency theory.

# Frequency Theory

Rinne (1865) and Rutherford (1880) proposed the early forms of the Frequency theory of hearing. Their theories were known as telephone theories due to the similarity between the waveform of speech sound in a telephone line and the incoming sound signal to the human brain. The theory gives an assumption that the firing rate of the auditory nerve has a wide range of 20 to 20,000 times per second. This assumption is important in relation to the theory's suggestion that the incoming sound waveform has a time domain representation that is associated with the manner or rate at which the auditory nerve fires. The said time domain representation, as well as the frequency analysis, is theorized to be processed in the brain, rather than in the inner ear.

The studies done in the late 20th century have proven the Frequency Theory incorrect in its assumption of the firing rate of the auditory nerve. Today, it is widely accepted that individual nerve fibers, including that of the auditory nerve, can only fire at a range of 300 to 500 times per second. Neural groups can only fire with frequencies up to 5000 Hz.

Most psychologists agree that hearing sound stimuli at low frequencies is accounted to the frequency theory, whereas those at high frequencies are attributed to the place principle. Sound stimuli in mid frequencies are believed to be rightfully accounted to both hearing theories.

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