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| The Sounds in Silence |
| On Infrasound and Resonance |
| Sean Stathatos |

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The Sounds in Silence

There is a story that is told about Nikola Tesla. As the story goes, he put a small vibrator on an iron column in a laboratory in Manhattan and systematically altered its vibration frequency. An astute man, he noticed that different frequencies vibrated different pieces of laboratory equipment. He eventually found a frequency that made the floor and walls shake violently. Unfortunately, what he actually found was the resonant frequency of Manhattan. The pillar which held his vibrator was embedded in the building’s foundation and was transmitting his vibrations across the city. The police had to break down his door and ask him to stop. (Cheney)

This is an interesting story about an interesting man. That is all it is, though: a story. Although Tesla was well known as a pioneering electrical engineer in the early 1900’s (Cheney), he had a tendency to exaggerate his own accomplishments. (Gebben) However, it does provide a captivating example of the power of resonance. Resonance is one term we use to describe the movement of waves. It is also our primary means of producing communicative sound: air leaving our lungs rushes across our vocal chords, which vibrate – or resonate – with the frequency we create. However, there are many sounds that we cannot hear because they resonate at frequencies outside our hearing range. There are two broad types of sounds that we cannot hear: infrasound and ultrasound.

Infrasound is sound at frequencies lower than 20 Hz – sound at a frequency too low for most humans to hear. So, if you can’t even hear it, why should you care? Because you can still feel it, that’s why. Infrasound and other low-frequency sounds can have special effects on human beings like you and me. These sounds can cause psychological and physical feelings from fear to chills to nausea. Because of their low frequency, they can travel very long distances and still impact people. Infrasound is more than just background noise now; it has present and potential uses in society.

One type of infrasound is that which appears to cause fear. Hearing a sound at a frequency close to 19 Hz can cause people to feel apprehensive and see what they think are ghosts. Vic Tandy, an engineering designer at Coventry University, was working late one night when he started feeling uncomfortable. Many of his coworkers claimed that the building was haunted, but he was naturally skeptical and attributed most of the strange sights and sounds up to “the wild cats, wild other furry things, moving pressure hoses… or some sort of lighting effect.” (Lawrence) Over time he began to notice more strange things. He writes, “There was a feeling of depression, occasionally a cold shiver, and on one occasion a colleague sitting at the desk turned to say something to [Vic Tandy] thinking he was by his side. The colleague was surprised when [Vic Tandy] was found to be at the other end of the room,” (Lawrence). On that same day, once everyone else had left, Tandy started getting the feeling that he was being watched. Soon, a figure appeared to his left. Taylor describes it as, “indistinct and on the periphery of his vision but it moved as [he] would expect a person to. The apparition was grey and made no sound” (Lawrence). Once he finally turned to get a good look at the thing that was watching him, it disappeared as soon as he faced it. At this point that Tandy decided he was going crazy and left for the night.

The next day, he came back with his fencing foil because he needed to use some of the lab’s tools on it. He placed it in a vice, and noticed that it had started shaking violently. Tandy realized that something had to be applying a force to the foil and, after moving the foil to different locations in the room and determining the effect on its vibration, realized that the room was filled with a “low frequency standing wave,” that had a frequency of about 18.98 Hz (Lawrence).

So what does a 19 Hz standing wave have to do with fear? According to NASA, the resonant frequency of the human eye is about 18 Hz. (Ohlbaum). Other studies have determined that “every organ and tissue has its own acoustic properties” and will resonate at low sound frequencies. (Mahendra) It is thought that the physical resonance of human organs, particularly the eye, in response to infrasound causes corresponding emotional of anxiety, stress and awe.

# Now, where will you find this technology in modern applications? Infrasound has been explored as a potential weapon (Vaisman), and as a medical and therapeutic intervention (Payne). However, today, more than anywhere else, you can experience infrasound as part of audible music. The development of technology for music production and the rise in popularity of electronic music makes it possible to produce infrasound in a highly controlled way, and the emotional impact of music can be augmented by the judicious use of infrasound.

# Probably the best known experiment on the concert-based impact of infrasound in conjunction with audible music is the “Infrasonic” concert in 2003 in the Royal Festival Hall in London, England. (O'Keeffe) In this experiment, an acoustic scientist, an engineer, a psychologist, a composer and their associates created a concert of four contemporary musical pieces, designed for live performance at the Royal Festival Hall. They created low-bass infrasound at 17 Hz. with a seven-meter pipe and interlaced it in two of the four pieces, without telling the audience which pieces included infrasound. After each piece, the performance was paused and members of the audience were asked to assess their emotional response to the piece using predetermined scales, and to “report any unusual experiences [and] rate their intensity” (O’Keeffe) Different audiences attended each of the two concerts. Approximately 22 percent of the audience reported odd reactions to the pieces containing low-base infrasound, including anxiety, chills and a sense of coldness (O’Keeffe). O’Keeffe and Angliss speculate that sacred music in church, traditionally played on organs which have pipes exceeding seven meters in length, also produces low-bass infrasonic vibration. This vibration should augment the feeling of awe which sacred music usually evokes.

This experiment attracted substantial contemporary media coverage. A Sydney Morning Herald article published September 9, 2003, **"**Sounds Like Terror In the Air,**"** can be found here: <http://www.smh.com.au/articles/2003/09/08/1062901994082.html?oneclick=true>.

Music and sound have been used for a long time to augment the emotional impact of film. From the time silent films first became “talkies,” producers and directors experimented with how the soundtrack and sound effects could add to the artistic and emotional impact of their films. In the movie “Blackmail,” made when sound technology was first being introduced, Alfred Hitchcock “repeatedly employs off-screen sound; that is, he offers a sudden noise, bit of dialogue, even a cry while withholding a shot of the sound’s source, thereby producing an aural equivalent to his customary build-up of visual suspense…” (Telotte) Known as a master of suspense, Hitchcock used sound effects to add tension and anxiety to his narrative.

Nowadays, sound effects and soundtrack music are universally used in movies and in video games to shape audience and player response. It would seem very strange to find a film, a game or a television show which lacked musical accompaniment. Music directs our psychological response to a character and cues our understanding of plot development. The soundtrack fuses its own emotional meaning with the meaning of the story or the game. The commercial potential of infrasound as a part of the soundtrack to augment our responses of horror, anxiety and awe within a movie or video game is obvious.

In facts, directors are venturing in this direction. In making the revenge-horror film “Irreversible,” director Gaspar Noe and musician Thomas Bangalter (of Daft Punk) deliberately used infrasound to augment the tension for a violent scene in a nightclub. Gaspar Noe stated that he and Bangalter devised two musical overlays, as would typically occur in a nightclub, and then added a low bass tone at 27 Hz. Noe said that most people cannot actually hear the tone, but it produces a physical effect which is more disturbing than what is occurring on the screen. Many people “can take the images, but not the sound.” (Noe) He said that is true even though the sound is not audible. Thomas Bangalter has gone on to deploy his musical expertise in electronic and bass music to create soundtracks for such popular hits as Tron: the Legacy, although he has not said whether he used infrasound for Tron.

It might be asked whether the use of infrasound is justified, because it manipulates the audience without conscious audience awareness. However, directors and game creators have always used the traditional musical soundtrack, and sound effects, to intensify the audience experience. A careful use of infrasound seems to be a logical tool within the director’s creative toolbox. If the infrasound is overused, viewers will simply recoil from the movie or decline to play the game. In fact, infrasound may have been overused in the film Irreversible, described above; the film, which included a rape and a murder, was so graphically violent that it repelled most viewers. It was not well attended. The infrasound coupled with the graphic violence may have been too effective. The audience, overly saturated with tension, seems to have stayed away, so it appears that the audience subjected to too much infrasound will take care of itself.

This said, a long-time player of video games can feel the vibration of the music and sound as he plays the game. In games which include suspense (most of them do) the soundtrack is always used to intensify the emotional reaction. The player appreciates suspense as part of the play experience, responding to it and attacking within it as part of the physical aspect of the game. In many or all of such games, the soundtrack descends into the bass range and noticeably vibrates within the body. Infrasound is a logical device for the creators of such games, particularly their soundtrack writers, to intensify the emotional response of anxiety and tension. I suggest that if game creators are not already building infrasound at approximately 17-18 Hz into games of suspense, such infrasound is tool to consider.

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