

*Is the "Sacculus" our inherited key to  
experiencing the very soul of music – Rhythm?*

## **Final report**

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## Background

The background to this project proposal has developed from subjective observations and is mainly of empirical nature. People, who are visiting music clubs, discothèques, concerts and sometimes even other "large crowd events" e.g. a football match, might often experience emotions of elated or aroused nature.

There are several common parameters characterising people participating in such events e.g. the same interest within the group or the feeling of being a part of a social community. But another more subtle reflection made, is that the sum of perceived sound volume is of great importance, that is, there is an experience of energetic power - volume – pleasure. Accordingly, I have found it of interest to investigate the emotions felt due to the perceived sound from external sound sources such as loudspeakers or a chanting crowd and sound perceived from an internal source such as the own voice.

## Motivation/Phenomena of interest

An empirical observation made is that the impact of a certain song or groove in e.g. a discothèque seems to be greater when the volume is loud. At such occasions it could almost seem like the melodic and harmonic structure or mode is of less importance than the beat of the rhythm section. This particular beat is quite often pumped out in loops with one or two repeated rhythmic patterns over a longer period of time (4-7 minutes). Certain tempos and rhythmic patterns may be preferred depending on the dance ability and, thus, these patterns may not be as crucial as the volume of the bass and drum registers. As mentioned, we may not only favour music at loud volumes, we also seem to prefer that it is presented equalized with the bass and drum registers accentuated. That there is an attraction towards this kind of sound image seems to be confirmed by the fact that people often equalize the audio output in their home stereos, car stereo, portable sound devices, television and computers like a "smiling mouth". This equalization method creates a sound perceived as rich in the bass register and "tingling" in the treble registers while the middle register (quite often perceived as "hard and/or nasal") is diminished. Such a strategy does not seem to be related to the volume of the sound source. The volume perceived might be of greater importance when physical activity is involved e.g. dancing or practicing aerobics and so forth.

The above mentioned relates to external sound devices. Another aspect of great interest is the perception of one's own voice. When people gather in large groups to chant or sing, the amount of volume perceived may be of importance. It also seems to be more satisfying from an arousing point of view to be part of the chanting or singing (e.g. member of a choir) than to be the observer or listener. Whether this is mainly for social or physiological reasons is yet to discover.

## State of the art

Neil Todd (1), a psychologist from the University of Manchester has made research on the sacculus, an organ of the inner ear. This organ forms part of the balance regulation system. Although it has no hearing function, it responds to sound frequencies that predominate in music.

The sacculus is connected via the vestibule system to the hypothalamus. This particular part of the brain is the centre for needs such as sex, hunger and hedonistic actions. N. Todd has developed the theory that the sacculus is involved when people get their emotional spectrum "coloured" by listening to music. This would happen due to the fact that the Sacculus is connected to both the hypothalamus and the balance organ. This implies that people who get a buzz out of spinning around in rollercoaster's and so forth, are more likely to enjoy music performed at loud volumes!

N. Todd's paper concludes that in order to get the Sacculus stimulated, the music or sound perceived has to be at loud volumes, that is at least 90 db and in the frequency range between 50 – 1000 Hz, with a peak around 325 Hz.

Considering the second question in my proposed project the perception of one's own voice, C. Pörschmann (6) has suggested that three major parameters are involved when hearing your own voice. These are the sound transmission through the air, the bone conducted sound and the reflections of one's own voice from surfaces in the environment. For example, a well known acoustic phenomenon occurs when a person hears his voice recorded and does not recognise it due to the fact that the bone conducted sound is eliminated. A similar phenomenon can be observed when one of the three sound paths is changed.

Pörschmann concludes that the air conducted sound from mouth to ear is perceived almost as presented, that is with a slight bump around 2.5 kHz and a slope from 5 kHz. A decrease of 6 db in the frequency range between 150 – 4000 Hz is perceived if one of the sound ways is blocked. The bone conducted sound is found to be the dominant factor when perceiving sound at about 1 kHz.

N. Todd estimates that the sound volume in the larynx when phonating at high sound levels is 130 db and Pörschmann concludes that the bone conduction is dominant at about 1 kHz. If one of the three parameters for hearing your own voice is excluded the total volume decrease would be 6 db. So, accordingly, the acoustic sound perceived from the own voice could be about 124 db at 1 kHz, in the upper part, but within the range of Sacculus stimulation.

## Conclusion

The finding that some people get aroused from music perceived in certain volumes and at certain frequencies is not surprising. However, it would be very interesting to find out which parameters inflect on the perceived emotion, and what boundaries the parameters have in terms of "keeping within the attracted area".

The rhythmic patterns of music aiming at being played at discothèques or dance clubs are often presented with a percussive sound image. If the original mix of a song doesn't include such a rhythmic pattern or is not equalized with raised bass and drum registers, it will be done in a so called remix. "Whitney Houston's smash hit ballad "I will always love you" may be used as an example. If or when one experiences that song on the dance floor one will find it faster, rhythm oriented and with a greater bass and drum register peak than the original recording, all in order to give it the right format and experiencing the music appropriately from a dance ability point of view.

People chanting or shouting at special events seem to be above the boundaries of culture, this common behaviour may be observed in all cultures, from chanting Indian tribes to shouting football crowds. Some inherited psychological mechanism seem to be triggered by hearing one's own voice in combination with other people's voices and /or by participating in the social part associated with the event?

## Project Proposal

The first investigation needed in this project proposal would be to find out which parameter is the main trigger when people experience pleasure at the discothèques and in concerts where the volume of the sound perceived is loud. This would be an interviewing qualitative research. Crucial questions about whether going to a certain club mainly depends on group pressure instead of sound experience or whether going to a concert depends on visual experience or sacculus stimulation have to be formulated. Further single questions and combinations of question would have to be formulated. This method would also be my choice when searching for the reasons for why these, often male dominated events e.g. a football match is so arousing. Is it the actual interest in the event or is it the sense of being a part of a homogenic group? Or is it the pleasure felt (sacculus stimulation) when participating in chanting and shouting at loud volumes?

A quite different type of research method would have to be used when investigating the Sacculus stimulation. It would be of interest to look separately at the music experience and the experience of one's own voice in order to clarify whether the volume parameters and spectrum parameters may be translated back and forth in regard to an external music sound source and the internal sound source of one's own voice. According to N. Todd this has to be done by measuring the neck activity. When the Sacculus is activated it evokes electrical signals in the neck muscles, so by measuring the neck electrical signals during sound instead of balance regulation it should be possible to draw conclusions regarding relations of sound, to the sacculus. I suggest that this method should be combined with an interviewing part, consisting of grades of experience at different frequencies and volumes.

## References

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