

About the perception of sound

by Klas Dykhoff

When we perceive a film we use sight and hearing. This seems to be an obvious statement, but there has been serious attempts to involve other senses as well.

In the movie *The Earthquake* (1974) a system called Sensoround was introduced. On one of the soundtracks of the print, a signal was recorded that triggered an oscillator that produced low frequency rumble that was played through specially installed bass speakers in the auditorium. When an earthquake occurred in the film, this high energy low frequency audio made the intestines of the audience vibrate violently, thus giving the feeling that the whole building was shaking. The audible portion of sensoround was also quite shattering, further adding to the effect.

In *Polyester* (1981) a system called Odorama was used to engage smell in the perception of the film. Every spectator was given a small card prepared with smelling dots which were to be scratched and smelt upon at certain given moments in the film.

Both these attempts were soon forgotten, partly because the films that were supposed to benefit from them, were beyond rescue anyway, and the handling of the smellingcards and the shaking of the spectators interfered with the perception, rather than enhancing it. The basic idea though isn't bad at all as we soon shall see.

When I was writing my book, *Ljudbild eller synvilla?* (Soundscape or mirage? currently only available in Swedish) I did some research into the differences between sight and hearing from a perceptual point of view. I was aware that these senses affect us in different ways, but what are the differences and how can we, as sound editors or sound designers, benefit from them? Fifteen years of soundwork in the Swedish film industry had taught me enough to realize that what Walter Murch, Randy Thom and others write about sound in film probably is true, but I was curious to find out why they're right.

Hearing seems to have a direct link to our subconscious, as does smell. Anyone who doubts the subconscious power of smell can make a survey at the perfume counter in any department store, to see what people are prepared to pay in order to manipulate their odor.

It seems to me that sight is a primary sense, and smell and hearing are confirming or secondary senses. If you see a nice looking human being, the good smell confirms what your eyes are telling you. If he or she smells strange, you get suspicious. Or to be more precise; if the smell fits in with the general impression, you don't think about it at all, but if the smell doesn't fit in, then you think about it and get suspicious. Why? Because in that case you must evaluate your first visual impression as well as the impression given by the smell.

In *Fight Club*, Marla (played by Helena Bonham Carter), sounds like a heavy man wearing slalom boots when she walks around in the house, despite the fact that she's an average sized woman. This gives the audience a hint that there's more to her than meets the eye. This is obviously the result of clever Foley, adding to the description of her characteristics, from the point of view of the main character (played by Edward Norton). We see these characteristics in her, despite the fact that their origin is aural. Furthermore we understand his feelings towards her, as we experience these characteristics together with him.

Brain surgery for dummies

It's quite obvious that different individuals use their brains in different ways. Some are musical, some are capable to drive race cars faster than anyone else and some can paint or draw. These differences occur despite the fact that their brains look and work more or less in the same way.

We allow quite a wide span of abilities and disabilities among individuals who we consider to be normal. It's OK for a middle aged person to draw like a six year old, and it's acceptable to be unable to sing or play a musical instrument.

The left part of the brain is said to handle tasks that are connected to logics, while the right side is the more intuitive and creative part. The left side of the body is controlled by the right half of the brain and vice versa.

But, in a left handed individual some of the logical tasks are handled by the right half of the brain, but not all of them. Left handed individuals, generally speaking, have certain characteristics that are different from right handed. This wide span of abilities and disabilities among "normal" people makes it quite impossible to predict how different individuals perceive for example the same moviescene or piece of music.

Under normal conditions one part of the brain can block or dampen other parts. If one of these dampening parts get hurt, a person can suddenly go through dramatic changes. There are examples of elderly people who have had parts of their brains destroyed by dementia, and who, as a result of this, suddenly have begun to paint or play music, something they've never been able to do before. Some drugs also seem to have this effect, they turn off certain parts of the brain thus allowing repressed parts to get in to play, causing hallucinations and a distorted perception of reality.

When we make a film, we're in fact also trying to distort the perception of reality in the audience. For 90 minutes we want to create the illusion that the screen at the far end of the theatre is in fact the reality, and that the flat images are three dimensional. To a large extent it's the sound that creates the third dimension, the depth, but our minds fool us into believing that we see it.

Professor Paul Robertson, an English violinist, has been researching into how the brain perceives music. Some of his astonishing findings are presented in the television series Music and the Mind.

Among many other things, he presents research where the brain of a male, practicing scales and playing Bach on a small keyboard, is x-rayed. One of the most amazing results of this examination is that the part of the brain that deals with listening is inactive while he plays. On the other hand the part which deals with visual impressions is active when he plays Bach (i.e. is creative) but not when he practices scales (a non creative task).

In another part he interviews a young deaf woman who plays the viola in the London Symphony Orchestra. When asked how this is possible, she answers that hearing is only a part of the very complex feedback mechanism that has to take place while playing music. She also says, and this is the most interesting in my opinion, that all musicians use their other senses together with their hearing when they play, they're just not aware of it. For some reason our minds let us believe that we are hearing when we are in fact feeling or seeing, and that we are seeing when we're hearing. Why is that?

The bandwidth of our senses

There's been attempts made to measure the capacity of our senses. By counting the nerve cells in for example the eyes, and calculating the maximum amount of

data each cell can transmit, scientists have been able to measure this quite accurately. The figures I present are translated into the computer unit bits per second (b/s).

Sense	capacity b/s
Sight	10.000.000
Hearing	100.000
Skin (Feel)	1.000.000
Taste	1.000
Smell	100.000
Total	11.201.000

The ratio between sight and hearing is 100:1. I guess everyone involved in film sound already suspected this. It's also interesting to see that smell and hearing, two senses that seem to be sort of related, have a ratio of 1:1.

OK now to the really interesting part. There's also been attempts made to measure the capacity of our consciousness. This is a bit more complicated. Different figures have been reached, but they're all in the region of 16 – 40 bits per second. Thus, we receive eleven million bits per second but we are only aware of forty. That's a ratio of 275.000:1!

One question that immediately springs to mind is: Where does the rest go? Obviously some of these 11.000.000 bits handle things like telling my pancreas how to behave or deal with keeping my body temperature, but still...

Another even more interesting question is: what decides which information actually becomes conscious, and how does this work?

Our consciousness is like a narrow beam of light sweeping across a big dark room. It can reveal a lot, but only a small portion at a time. These fragments of information are put together into a coherent image or impression. The constant decisionmaking that goes on that determines what information is to become conscious and what is to be ignored takes some time. This leads to a delay of all impressions. How much? Half a second to be precise. Everything we perceive is delayed by half a second. But in order not to confuse us, our minds fool us to believe this is not the case. There's a simple test you can do to try this. Put a finger on a hot surface. You will instantly and unconsciously pull back your hand before you feel the heat.

Déjà vu and other related phenomenon become quite interesting in the light of this knowledge. Our whole lives are in fact déjà vues, we have actually experienced this situation before, half a second ago! It's when the delaying mechanism in our minds gets out of synch, and sensory impulses that belong together arrive at different times, we get the déjà vu feeling.

The discrepancy between what comes in from our senses and what we're aware of and therefore are able to relate to others, make us all very alone in a sense. We can never describe the full complexity of an experience to anyone else. Perhaps we all know this in an subconscious way, and perhaps this is the reason for the admiration that musicians and artists get. They seem to be able to connect to this vast amount of experience that we all have but are unable to communicate. Or, maybe it's even more basic than that, maybe they're just able to give us a glimpse of their accumulated subconscious experiences, thus hinting to us that we're not the only ones alone with our experiences.

How does this apply to film sound?

Good acting is perhaps the ability to transmit more than 40 b/s that point in the same direction, while bad acting could be when the words and the body language are saying different things. When I edit sound I often try to give the characters some help by giving them audible reasons for looking away or stumbling on a line. In some cases this really helps the acting by bridging the gap between the contents of the line and the way it's being played. No actor has ever noticed this, let alone thanked me for making them appear better than they are, but that's the rule of this job. The better you are, the less you're noticed.

If we're only aware of 40 bits/sec, really strong experiences must to a large extent consist of information from within ourselves, things that we've stored in our minds. What's the actual content of the most scary scenes in, for example "Blair Witch Project"? Very dark shaky images that actually could be of anything, and the sound of heavy breathing, running footsteps and desperate screams. Why does it scare me? Because it opens a door into my deepest fears and anxiety, into my own memories of things that I'm afraid of. I.e. in a sold out auditorium, every single spectator is scared of different things in the same scene.

The spectators' imagination is by far the best filmmaker if it's given a fair chance to work. The more precise a scene is, the more unlikely it is to affect the audience emotionally. By being explicit the filmmaker reduces the possibilities for interpretation. The classic "B" monster movies where the filmmakers couldn't resist the temptation to show the poorly made monster, and sex scenes that are completely un-sexy because they leave nothing to the imagination of the spectators are good (bad) examples of this.

The only thing required is the right trigger to start the experiencing process, and that trigger could very well be a sound.

What Randy Thom writes about using black and white images or smoke and extreme camera angles goes right along these lines. By not showing everything the spectators are forced to go to other sources to fill in the missing parts. One source obviously is the soundtrack. With a minimal amount of visual information and sounds suggesting something, you can get the audiences imaginations running.

It's interesting to speculate about how much information the trigger must contain and how much it actually triggers.

In "Guinness book of world records" the worlds shortest correspondence is quoted. In 1862 the French writer Victor Hugo went to his summerhouse in the countryside, exhausted after finishing his novel "Les Miserables". After a few weeks of not knowing if the book had been released, if it sold and what the critics thought of it, he couldn't control his curiosity, so he wrote a letter to his publisher. The letter only consisted of: ?

The publishers answer a few days later read: !

Obviously both the question and the answer contained a lot of exformation or meaning, based on previous knowlege, that was triggered by the tiny amount of information.

A small sound cut in at the right moment in a scene can trigger a lot of exformation in the spectator, and it can be very subtle. You can do footsteps in Foley where you add some broken glass on the floor. No one will notice the glass, but it gives the audience an uneasy feeling.

Another example is the way we design the sound of punches, shots and car engines to add to the description of the characters in a film. Quite often the audience perceives this as good acting.

Why does it work?

One consequence of the limited bandwidth of our consciousness is the way our minds generalize and connect sensory impressions. The human race is designed for a world in sync. Our minds are geared towards connecting synchronized events.

If I'm given small pieces of apple and pear, I can quite easily tell which is one or the other, although they look the same. Why? Because I can taste the difference? No, obviously not. Humans can only distinguish between four different tastes: salt, sweet, bitter and sour. The rest is smell. Despite this (and despite the fact that most people are aware of this), we believe that we taste the difference, because our minds tell us so. I had the piece of fruit in my mouth so it's taste, basta. This is a mechanism that helps us get along with only 40 bits/sec.

In a film, all of us know that Harrison Ford wouldn't let another actor hit him in the face for real. We all know it's a combination of the fist passing a couple of inches in front of his face, the camera being in the right place, Harrison Ford twisting in the right way, and the use of a well designed sound cut in on the right frame. But in the darkness of the cinema we're all worried that Harrison Ford's character will get hurt and be unable to rescue the heroine. We can all see the power of the fierce blows, simply because our minds generalize the sound and the images into a visual impression. In order not to confuse us, our minds say "you are seeing this" instead of telling us the whole truth. The truth would probably use up a lot more bandwidth.

So what about Odorama and Sensorround? Well used in the right way, feel and smell could also be generalized by our consciousness, thus improving the perception of the images and ultimately the narrative. However, I must confess, for the time being I'm quite happy with only sound and vision.

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