10.9.4 Sound event vs. auditory event

On the one hand, it is possible to document the operational behavior of a guitar amplifier via formula and results of measurements; on the other hand, it may happen by verbal description of sensory perceptions. "*Smells like a goat*" would be a genre-typical choice of words, or "*has one hell of an oomph and creates just the right sizzle*", so stick with auditory perception. If everybody knows what an oomph is, this description indeed does help. However, because scientists often do not know what an oomph is, and because they like to quantify things into interval- and relational scales, there are also numerical specifications such as "*cutoff frequency at 5238 Hz*". So, we have, on one side, physics with its objective sound-event data: 100 W, 8 Ω, 5238 Hz, 10 ms. On the other side we find the auditory event with verbal, subjective judgments; louder, much more authentic, vintage-like, throaty sound, too short sustain, etc. In between there is the magnitude estimation: twice as loud as … , just noticeable reverb amount, 50% longer sustain.

Guitar amps mostly do not play for measuring equipment but for people. Okay, they also play for tables, chairs, the dogs of innkeepers and their fleas, but predominantly for people, after all. Whether a measuring device certifies an increase of the effects-mix from 1% to 2% is insignificant if this remains inaudible in both cases. The physical sound event leads – if it is audible – to an **auditory event**, and it is only the latter that is judged by the listeners. The assessment is anything but objective: whether an amp-sound is judged as being good or bad is a matter of taste and depends on subjective criteria and also on environmental conditions. Everybody knows **optical illusions,** and there is no surprise in the fact that there may also be auditory illusions. Nobody will assume that a car speeding away on a straight road actually decreases in size although the optical angle that it occupies in our visual perception indeed becomes smaller. The brain will correct for the shrinking image on the retina and, in a way, creates an illusion. Is it actually an illusion? The car has not shrunk, after all, just the picture on the retina! Anyway, the term "optical illusion" found its way into everyday language.

What is the reason for such illusions? Is a lion that only then a lion when we see it in full, or is it a lion already as it steps out of the bushes, only half visible? This is a clear-cut case of evolution and/or selection. It was conducive to survival to supplement fragmentarily arriving perceptions, and to correct distorted sensory impressions. The immense flood of data arriving from our sensory receptors needs to be reduced momentarily by many orders of magnitude: the data flow taken from a stereo CD amounts to about 1,4 Mbit/s but at best only 50 bit/s of that arrives at our consciousness. However, the synapses working on our internal signal-processing do not just throw, without discretion, 99,996% of the incoming information into the bin; there are rules – but rules that may change from one second to the next, with our cooperation but also without. Since we perceive our environment exclusively through this information-reducing filter, the philosopher arrives at the conclusion: **nothing is as it seems** – and he seems to be right. The "seems" is attributed to the realm of the perceptions (auditory event), the "is" to the realm of physics (sound event). It must not surprise us if a guitarist perceives sound changes if he is being told that a coupling capacitor has been swapped – although the amp remained in fact untouched, and merely the judgment criteria have undergone a change. The opposite may also happen: a capacitor is indeed swapped but nobody hears a difference. And of course there is the third variant: the swap is clearly audible. There are countless guitar amps, if not more – for the individual case no remote diagnosis can be established. The following explanations can therefore only impart basic knowledge but not offer retrofitting plans for specific amplifiers.

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Fig. 10.9.11 shows some optical objects. In the first picture we see two crossing straight lines, in the second two overlapping circles. Or are these in fact other objects? Aren't there two angles with meeting apex in the first picture? We could just as well assume that – but the crossing straight lines are simply more obvious. **Our brain always chooses the interpretation of reality that is more likely**. In this case, this is the crossing of two lines (or two tree branches that have fallen on top of each other). For the same reason we do not recognize, in the second picture, a crescent and a waning moon with a convex lens-type area in between, but two circles. In the third picture, we see two triangles on top of each other that do not at all exist in the drawing. In particular, the "upper", white triangle is predominantly "make-believe" rather than "actually being". The right-hand picture conveys a depth in space that is not at all present in reality. And although this picture does not change, it can "jump" in our perception: one moment we see a cube on the floor, the next we see a cube hanging (fastened with its rear surface to wall) towards the left … or towards the right. Visual perceptions seem not to correlate perfectly with the optical stimuli.

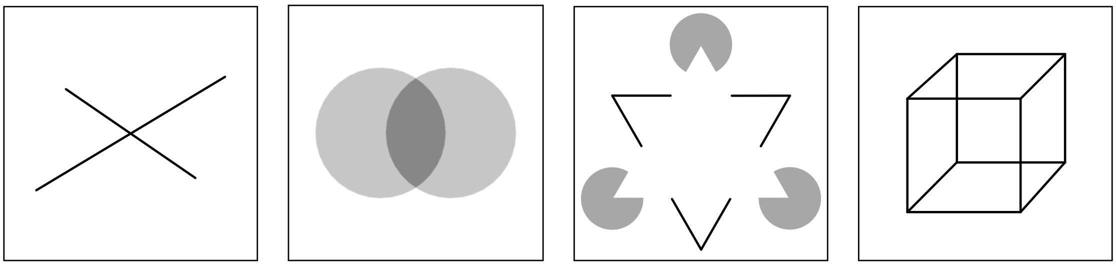

Fig. 10.9.11: Examples regarding the visual perceptions of optical objects. For more examples see D. Picon 2005.

Consequently, we should not be puzzled if auditory perceptions change as well, without any alteration in the acoustical sound event. A special experimental methodology is necessary to establish whether or not there is in fact a **causal correspondence** between a change in our auditory perception and a change in the physical sound event. How would a guitarist who has just swapped a capacitor in his amp (and now plays to check out the result) judge whether any perceived difference in sound is due to the changed capacitor, or due to the (unconsciously) changed way of playing, or due to the (unintended) change in the listening position, or due to changed judgment standards (autosuggestion)? Psychometrics has a few hints here: for example, the sounds to be judged should be presented such that the test person does not know which sound is presented at the given time ("blind"-test). The sounds should have a duration of only a few seconds, and the interval between sounds should be short (about 0,5 s). In a comparison of pairs (A-B-A-B) only a single parameter should be changed at a time. How much does a demo-CD for replacement pickups tell us if there is a different guitar-riff for each pickup, and if possibly different players have recorded the riffs? Not much!!

The first run-through of a listening experiment could, for example, contain simple **nominal verdict**s: the perceived sounds sound **the same or different**. To increase the certainty of the statements, it is necessary to have the subject judge identical sounds without the subject knowing that this pairing is included. A subject that repeatedly hears differences when identical sounds are presented (perceived A-B-A-B is in reality A-A-A-A) will either uncover faults in the experimental setup, or he/she is unsuitable as a test subject. If two sounds are, objectively, not significantly distinguishable, the question about which sounds better is moot.

If A and B are judged as sounding different in the auditory experiment, the second experimental stage can serve to ask about comparative ranking characteristics (**ordinal characteristics**): "*I like B better than A.*", or "*B sounds more distorted than A*", or certainly even "*B has more oomph that A*". In the last stage♣, quantitative **cardinal characteristics** are addressed: "*I would spend 100 € more for B.*"

In order to judge the subjective difference in sounds between A and B, the exact objective difference between these sound needs to be known – that should be a matter of course. For a listening test on the sound of capacitors (Chapter 10.9.3), this implies that the amplifier is always driven by the same signal, i.e. not by a guitarist (with a guitar) playing this now and that then. Rather, the guitar is recorded *once* in an appropriate way, and this recording is fed to the amp in an identical manner for the listening test. Specialist knowledge is indeed required in order not to destroy the sound already by the experimental setup. As a result, the following could be obtained: "*Of 20 subjects only 3 could hear a difference between A and B.*" Or something like: "*15 of 20 subjects judge A as sounding better but would on average accept no more than 10 € additional cost.*" could be the result. Still, even such tests leave questions unanswered: anybody who has not personally participated will not know whether he/ she would belong to a) the 15 or to b) the remaining 5, and if a), then the pecuniary equivalent might be as much as 500 €, as well. In general: if I am asking for the opinion of someone else, then I will receive the opinion of someone else – that is highly trivial. If I want to rely solely on my own opinion, then I need to test everything myself (and why not?). If I do ask another person, I might be i.a. interested in how reliable this person's opinion is. In such a case this approach holds: for a prejudice-free subjective judgment of objective issues, blind tests provide a powerful tool.

But what about those instances when the sound of an amp changes without identifiable objective reason? Those cases when an amp has lost its unique sound after a repair job, although it was – embarrassment city! – accidentally shipped back without having been opened up? The case of the guitar that never sounded right again after it had been kidnapped for a stage-quickie by a pal. Or the case of the capacitor-swap that led to a sound miracle although everybody (or rather all "studied physicists") tirelessly continues to emphasize this to be impossibly? There could be physical reasons (transport, shift of a slightly loose guitar neck, stray capacitances), but we might also see in such cases the impact of judgment benchmarks that are easily influenced. Most people fancy themselves to be superior to the average in many areas, and prefer that their equipment to stand out from the mainstream: alloy wheels … or copper caps. No sooner than a prejudice takes hold, it is pampered and cultivated – the smallest confirming hint is scraped up and blown out of proportion while every counterargument is conveniently ignored. As a rule, every confirmation is trustworthy while every disagreement is questionable. No one is spared this kind of delusion: 94% of all scientists at university deem their research to be above average! *The deeper reason for our biased dealings with information stems from a conflict between the search for truth, and the search for harmony and for agreement with ourselves. To admit that one has been wrong can, after all, chip away at one's self-esteem and one's image.* [R. Degen, Lexikon der Psycho-Irrtümer – *lexicon of psycho-errors*]. This is why an assumed change can lead to a change in perception. If, after 100 h of playing the new capacitors, suddenly the treble comes to life, the underlying mechanism is not necessarily an objective reason – the belief is already sufficient. It is a rather big paradox that training can render our hearing more precise but at the same time more susceptible to influence.

♣ These results may be achieved as well in a single run-through, if a matching evaluation-statistic is employed.

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That the brain can be trained is without a doubt. **Practicing** for many years fine-tunes the auditory performance, makes small differences stand out, allows for more comparison patterns to be available, and enlarges the sensory areas in the cortex. From the awareness of above-average hearing-prowess, the idea can easily arise that "the whole hearing" is now perfected and has become the unswayable calibration-standard. In this, it is easily overlooked that numerous auditory functions are not (or only to a very small degree) trainable, after all – they function just as they do for the untrained and are therefore – relatively seen – worse off than at the beginning of the training process.

An example from optical processing: for the cube in Fig. 10.9.11, we can decide whether we want to see it as one whole object (the cube), or as individual lines. Everybody with normal vision can do that; it does not require special training. For acoustical objects, however, different rules apply: in a complex sound made up from partials (harmonics) it is much harder to hear individual partials; often it is even entirely impossible. A simple trick may help: a special (non-masked) partial is switched off (filtered out) for a short time and then switched on again. At the switching-off instant we hear, as expected, a change in sound (thinner, more hollow). As the partial is switched back on, there is a surprising effect: first, the thinner, more hollow remaining sound is joined by an individually audible sine-tone that "melts" into the remaining sound within a few seconds to eventually form the original sound. Something new, especially when appearing abruptly, is deemed important, and the brains switches to "make individual object audible"-mode. After some seconds, the new additional object is categorized as a kind of prodigal son perfectly fitting in with all other objects, and the precedence circuit is switched off again: the partial is not audible per se anymore. No training can change this effect. The auditory perception changes although the sound remains static! On top of such autonomous (endogenous) signal-processing algorithms, other external (exogenous) signals affect the perception process: directional hearing is influenced by visual clues, as well, as is the impression of reverberation and even speech intelligibility. Nothing is, as it appears, and everything appears different

A real-life example shows how difficult listening test can be: in a pretty hefty pickup comparison test (Gitarre&Bass 2/05), there are 10 pages of verbal assessments: *"In comparison almost mushy ... the picking attack substantially softer and brittle ... surprisingly glassy and rich in harmonics ... an entirely different spectrum in the mids ... far less richly colored ... acutely transparent and translucent ... a sound beautifully soft and compressed ... a very creamy tone that however seems a bit dull and lackluster ... although completely covered in wax, the pickups sound open and as airy as un-potted ones.*" These short excerpts indicated that clearly audible differences must exist between the judged pickups. Some 2 years later, the same magazine publishes a flash-back to the same test. This flash-back arrives at the conclusion that "*in fact all models sounded almost the same."* (Gitarre&Bass 5/07) The difference between "*entirely different*" and "*almost the same*" has to be seen – according to the flash-back – in the different recording situation. Mind you: for "*almost the same*", the recordings were not done in a garage but again in the recording studio, and getting "*good and professional results.*" Based on this, every reader can pamper his personal prejudice: one will shell out 400 € for a pair of PAF-clones and enjoy the exclusivity, the other will (because of "*almost the same*") stick with the equipment he already owns, and prefer to perfect his finger vibrato – chacun à son goût. Another one may comment on the published sound examples from the above test with "*You must all be mad! There's nothing to hear but one and the same pickup again and again!*" (Gitarre&Bass 4/08). It does dignify the author of the article that he has not withheld this comment from his readers.

