

PERFORMANCE HALL ACOUSTICS FROM THE POINT OF VIEW OF THE SOLO SINGER

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1 INTRODUCTION

This paper attempts to bridge a gap between the perception and language of the acoustical professional and that of the performing opera singer. The author is in the unusual position of having practiced both professions at a high level. After over twenty years as an acoustical consultant with a broad base including noise control as well as room acoustics, he performed for eleven years as a professional opera singer. Now returning to the ranks of the acoustical consultants, he is interested to see how much of his experience as a soloist on stage can be of interest and use for his fellow acousticians. In addition to having designed large numbers of performance rooms for schools, churches and colleges, he has sung as a soloist in well over 100 different concert halls and opera houses, including New York City Opera at Lincoln Center, Bayreuth Festival Hall, Deutsche Staatsoper and Deutsche Oper Berlin, Staatsoper München, Liceu Barcelona (the new house), the new houses in Göteborg and Copenhagen, Gasteig München, Gewandhaus Leipzig, and the new opera house in Seoul, Korea, just to mention a few.

2 THE SINGER'S FEELING FOR HIS OWN VOICE

A singer's feeling for his own instrument is a fragile thing. All acousticians know a little about it, having noticed how different one's voice "feels" in an anechoic chamber and a reverberation chamber. In addition, we have all heard our own voices recorded; for most of us the first experience of this is a shock. The everyday experience of the concert and especially opera singer involves all of this. Any practical room will be somewhere on the scale between the two extremes, and what the singer hears of his own sound differs from what the listener experiences, due to bone conduction, directivity and diffraction effects which colour the tone heard by the singer himself.

2.1 The "Natural" and the "Learning" Singer

One can perhaps separate singers into two categories. The first is those that have a "natural voice". It works just as it naturally does and does not need much training to reach a professional level. Such singers have some advantages. They do not have to think so much about how they sing, and if their natural voice pleases and they are otherwise musical and smart, they can enjoy a "natural career" as well. The drawback is that when something goes wrong, they may not know how to fix it, and even if nothing goes wrong, they are often not good teachers, since it is hard to teach what you have not yourself had to learn.

The other type of singer is more common: he has to struggle to learn the craft, which is incredibly complex: an athletic activity in the sense of requiring coordinated strengthening and relaxation of specific muscle groups that are normally used for quite different activities, like yawning and swallowing, and which are burdened by habitual patterns. The human body is optimized for complete operations. Reaching a hand out to grab something involves a huge number of muscles

and precise timing, and changing such patterns is a very difficult task. Brain research has taught us that it will require establishing and myelinating new nerve paths, and these will have to compete with the old ones which have served us well or ill as we already were. Learning to sing is, for most people, akin to relearning such habitual muscular patterns, and for most singers, achieving anything like perfection is a lifelong path toward an unreachable goal. The path must be interesting for one to keep going.

Of course, one has to say that the "natural singer" always has some problems and has to learn to optimize his instrument, but the author's experience with natural singers, of which there are many at the highest levels, is that they struggle less with the variables of acoustics than most "normal", technique-pondering singers.

2.2 The Singer's Need for Feedback

A singer is always trying to evaluate how his/her voice is functioning. The ideal is to know how your throat feels when you sing "right", i.e., when the vocal production is optimal. Then there is nothing you can do to improve on it, and what the audience gets is the best you are capable of giving, regardless of the room. Most "old hands" in the opera business would probably confirm that this is what they do, or at least aspire to, and if you are a successful singer, chances are, in addition, that your self-confidence is good enough to make you care rather less than more how a particular acoustical or contextual situation affects the impression you make.

In practice, however, most singers rely on their ears to a certain, and mostly large, extent. This is a largely subconscious process. Most of us get used to practising in a certain space, and we then optimize the vocal production for this space so that we feel well and good. The shock of then walking out onto a stage and suddenly "feeling" quite different when opening the mouth to sing, has caused many a singer to panic. Getting a hat placed on one's head when singing can have much the same effect, (depending on the angle of the hat!), and many singers refuse to sing with a hat!

With more experience, one can free oneself from this auditory dependence, but what most singers need very badly, is exactly feedback in all senses of the word, and that, in the daily grind of theatre life, is the hardest thing to get. The room response is one thing, but the feeling "how was I" generally accompanies most singers off the stage. We are self-critical and vulnerable, even if we tend to repress and cover it as best we can. Colleagues tend to say very little, and if anything, the kind of supportive words that feel good, but don't cover the whole truth. The theatre leadership can not be trusted to say anything useful; you will know how they liked it only when you do or don't get an invitation for another role. Critics are worthless, most of them are clueless about singing and like most people only know what they like and don't like, which is not too helpful for the singer, beyond perhaps welcome ego boosts when someone has liked him.

Because of all this, most active singers keep taking voice lessons. In that case a trusted ear evaluates the sound and can help to correct muscular errors that, over time, can bring a singer far from "his" ideal sound.

3 COMPARING THE WORLDS OF SINGER AND ACOUSTICIAN

This interface between singer and room is what interests us here, and the question here is how the acoustician can understand the comments of the singer and find practical points of connection and effective design criteria and remedies. As a person who has stood in both roles, that of the acoustical designer and the performer, I have to comment that the two worlds have (to me) remarkably little to connect them.

The acoustician can afford to sit back and consider this and that, calculate and quantify. He has all the time in the world, at least compared with the performer, and can be relatively dispassionate.

Numbers and maps have a nice, objective truth to them. The butterflies do perhaps come when the field tests are to show if he was right or not, but otherwise he doesn't have to worry much about anxiety.

The singer, on the other hand, is faced with events that happen a second at a time. The time horizon is very short, perhaps a few minutes when one has a longer solo passage, but within that there are adjustments to be made every second, and the concentration on the moment at hand has to be immense. The more of this process that can be made easy and automatic, the better. The experience on stage is life at its more intensive: nerves on tiptoe, sweat pouring, all senses pricked, stage directions to remember, musical cues to be heeded. The whole time something can go wrong, and it often enough does: colleagues miss their entrances or sing the wrong text, a crucial cue in the orchestra doesn't sound, etc. Strangely enough it *is* still possible, in the middle of a scene on stage, to think about home remodelling, the cold beer after the show or the camera you want to buy, but these are moments occurring in repertoire and stagings you know very well, and they are risky moments, at that...

How do the acoustics of the room affect the singer in this situation? It is easy to see how subjective the view from the stage can become, and almost of necessity is. Everyone has an idea, more often than not downright kooky and mostly impossible to translate into technical language, and it is more than difficult to systematize the various ideas into a whole. Acoustics is a convenient scapegoat for whatever difficulties the performer happens to have. It is like the "dryness" on stage. Stages are always "dry", the main reason being that stage fright draws blood away from the vocal cords, which should be well lubricated mucous membranes, and we think it is the air that suddenly dries up.

4. AN ATTEMPT AT DESIGN CRITERIA

The useful reflections for a singer would, as in the audience, have to be delayed between about 20-30 and 80 milliseconds. In bigger halls, the rear wall reflexes can be distracting, and if they are much later than 100 ms, they are probably detrimental, unless earlier reflections are numerous as well as noticeably stronger. It is surely good if the reflections can come from many directions, to imitate the situation in a smaller room, where the singers will be practicing, having staging rehearsals, etc. The trend toward large rehearsal rooms is a good one, as it helps to acclimatize the singer to a space without too much "support". The important factor is the "feel" of the sound, the way it surrounds your own direct sound like a sauce. Clarity of information is not so important. For the modeller, a combination of parameters including "strength" and a reflection distribution as mentioned could be developed. The frequency distribution of the reflected sound is also important and should be as one would aim at for the audience seats. The vocal formant at 2500-3000 Hz should be allowed to ring back.

For communication on stage, the problems are better understood, as they will be comparable with those experienced by the orchestra musicians. Here the acoustician probably has less to offer than the set designer in an opera. Set design can make or break an opera production.

Finally, there are the issues of balance and timing with the orchestra in the pit. The pit design can have a strong influence on the subjectively perceived balance on stage. There are theatres where the orchestra is difficult to hear on stage, and there are other situations where the sound of the orchestra feels like a gigantic wall that you despair of penetrating. The musical staff tries to help in balancing this during the staged orchestra rehearsals, and the singer has to trust their judgment. The acoustician can certainly help in this regard, but this topic has been well developed.

In most opera houses the singer has to get used to singing **before** the sound of the orchestra reaches him. In other words, he must anticipate the sound, always staying a little ahead of the orchestra, as he himself hears it. This can be hard on the nerves. Imagine making your very first contact with a famous, and very critical, conductor, singing from a point about 15 meters back on

stage! The famous director Götz Friedrich (long time leader of the Deutsche Oper Berlin) loved to "use the whole stage" for his stagings, and while they are visually very rewarding for the audience, singers often have to be in points "impossibly" far back. One can easily feel lost and must just **hope** to be loud enough and to stay synchronous with the orchestra and not half a beat behind.

The most interesting theatre to have sung in, from the author's experience, is without doubt the Bayreuth opera house, with Richard Wagner's famous orchestra pit. The audience side of the pit is folded over, making a "roof" above the violin sections and obscuring the audience's view of the whole orchestra. The musicians find this a relief, as they don't have to dress in black, and it is often very hot in Bayreuth in the summer. This pit has the effect of throwing the sound, particularly of the strings, back at the stage before it goes out to the audience. The winds sit under the stage, and that sound can travel a little more directly into the house, but also comes from a point farther away. The effect of this, in the audience, has probably been described often enough, and to this author, is little short of magical. On stage it has two effects. One, the orchestra is extremely loud, but therefore also audible at the lowest dynamic levels, and two, you can actually allow yourself to listen to the orchestra and sing **with** it. The author has experienced colleagues who were struggling to avoid singing ahead of the beat in Bayreuth.

The author found it acoustically comforting to sing in Bayreuth. Even though the orchestra sounds very loud on stage, the singers come through quite well, and it is lovely to be able to not think of always staying ahead of the beat. Farther back on stage, of course, this has to be considered nevertheless. Another fact mostly noticed during rehearsals in the house, is that more than some 5 meters from the stage lip, late "echo" reflections from the rear wall of the house can be quite distracting.