Understanding Room Acoustics and Speaker Placement

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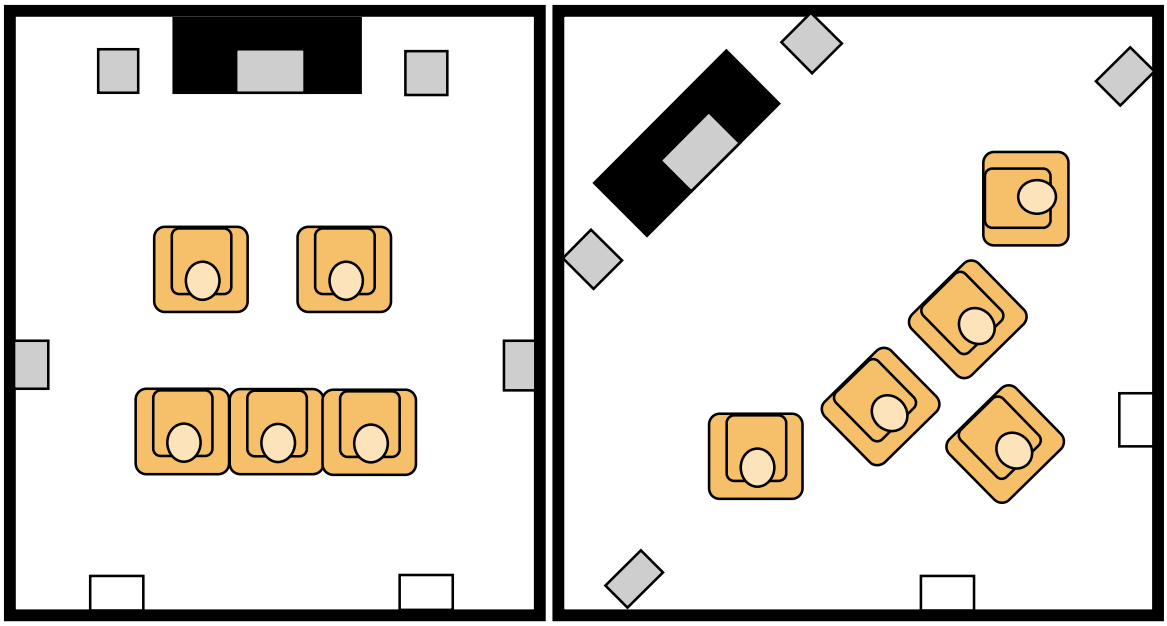
The room is the final audio component and, as such, it can make or break a truly satisfying listening experience. All rooms are different, so a truly guaranteed recipe for success doesn't exist. We all hope for good luck but, most often, things need help to ensure a really successful marriage of loudspeakers and room acoustics.

To keep things simple, let us separate the acoustical issues. First, is the shape of the room. Rectangular rooms are fine. Splayed walls, or other exotic shapes are not necessary for good sound. L-shaped rooms and three-sided rooms force us to be more creative, but can also work well. A diagonal arrangement, with the TV in a corner, is superb, which is fortunate, as it is often forced on us by windows, doors, fireplaces, etc. Note that the surround speakers are to the sides of the listeners, not behind them.



Two rooms arranged correctly for multichannel reproduction of movies and music. Both work superbly. The white speakers at the back of each room are for systems capable of seven-channel operation, a recommended option. In the arrangement at the right, the space behind the TV is perfect for a subwoofer. The seating is also much more sociable than the formal "theater" seating.

Now that we have a basic layout in mind, let's take a look at room acoustics. At some time in our lives, we have all been in a totally empty room, an experience in "untamed" acoustics. Sounds are extremely "live" - they reflect and reverberate. Clap your hands and the impact is repeated hundreds of times, as the sound is reflected among the hard flat room boundaries. Talk, and voices take on an artificial "richness" in the lower frequencies, and intelligibility is reduced because each utterance is prolonged by overactive reverberation. Put some carpet down, and things improve dramatically. Add drapes, some furniture, and the room is transformed into a much more pleasant space in which to live, converse, and listen to music and movies. Fill the room with too much "stuff", including lots of upholstery, cushions, heavy drapes, etc. and the place can become overly dead and stuffy. If we really want to optimize the room acoustics for the best possible sound quality, we have to be prepared to modify the décor. The goal is to make the room neither too live nor too dead. A happy medium is the objective.

Makes a Room More "Live"	Makes a Room More "Dead"
Hardwood or tile floor with small area rugs	Wall-to-wall carpet
Thin low-pile or looped-pile carpet	Thick, clipped-pile carpet with a felt or porous foam underlay.
Light, "Scandinavian", furnishing, leather upholstered chairs and sofas.	Bulky, fabric upholstered chairs and sofas, with cushions.
Lightweight curtains and drapes. You can see between the fibers, and blow through the fabric easily.	Heavy, dense weave, velour or velvet drapes. Fabrics that are more opaque, and that offer moderate resistance to blowing.
Flat unobstructed walls that act like big acoustic mirrors.	Walls that are broken up with irregularities, such as fireplaces, bookcases (excellent!), paintings, display cases, etc. to add diffusion.

If you are partial to hardwood floors, more attention must be paid to deadening the room with drapes and the type of furnishing. If you are partial to the stylish wood and leather "Scandinavian" style of furniture, then better think about heavy wall-to-wall carpeting. A combination of hardwood flooring with the light furnishings yields a stylish, but acoustically hostile environment for good sound. Thanks to the built-in ambience of multichannel sound, the error that is easiest to live with is for the room to be too "dead". Some styles, cultures and climates encourage hard, lively, rooms, with wood or tile floors, and even plaster or masonry walls to compound the situation. Others encourage the "cozy" surroundings of heavy carpets, drapes, and soft furnishings. It can be a difficult balancing act if decorating tastes does not match the needs for good acoustics.

Of course, there are dedicated acoustical devices that can be purchased to add absorption or diffusion to a room. These work, but they tend to stand out in a listening room that is also a normal living space. Be creative, and try to find some furnishings, artistic wall hangings, window treatments, etc. that maintain the homey atmosphere.

As part of this, we need to locate the speakers. If the television is part of a wall unit or entertainment cabinet, the tendency is to put bookshelf speakers into cavities that are sometimes available. This is only a good idea if you stuff the space around the sides of the speakers with acoustical absorbent, such as fiberglass, acoustical foam, or even old clothing, towels or rags. Just cover the visible part of the stuffing with something presentable and preferably acoustically transparent, like fabric. A speaker in an untreated cavity cannot sound as it was intended. It is usually better for the sound if the speakers are free standing or, at least, sitting on top of an open shelf or cabinet.

Floor standing speakers give us fewer options. Here things to avoid are placing them in corners or too close to a large television or piece of furniture – at least a six to twelve inch separation is advised. Ideally, they should be three or more feet from the side walls (the exception to this is if the room is arranged on the diagonal, as on the right, in the figure.).

The correct distance from the wall behind the speakers depends on the speaker itself. Conventional front-firing speakers are usually tolerant, and can work well either close to or far from the back wall. Multidirectional speakers, like bipolar and dipolar designs, need space, and some need to be quite far out into the room before they work really well.

If you experiment with the positions of full-bandwidth floor-standing speakers you may notice that several things are changing at the same time, and they may not be agreeing with each other. For example, as the

speaker is moved out into the room, it may sound spatially more "open" and natural sounding. However, the bass may be less powerful, or less even. Bass usually becomes more potent as a speaker is moved close to a wall, and even more so in a corner. However, the corner is the worst location for all other frequencies. This is the sort of thing that has led to the popularity of subwoofers, which can be located where they produce the best sounding bass, while smaller speakers can be located where they deliver the best sound and imaging for the bulk of the audible spectrum. Nowadays, there is another option, equalization. After years of questionable experiences with equalization, modern technology has provided us with the tools to do it properly. This enables customers to locate the loudspeakers where they need to be for their broadband duties, and then to use measurements and equalization to smooth out the bass response at the listening position.

Separate subwoofers still have advantages, because they allow us to optimize the woofer location. In general, a single subwoofer tends to work best when located on the floor in a corner. Experiment with the left or right front corners in an asymmetrical room, to see which is better. Adventurous spirits may want to try multiple subs. Move a subwoofer from a corner only if it improves a serious room resonance (boomy bass).

What about the wires? First, the longer the run from the amplifier, the larger the wire needs to be, e.g. 12-14 gauge. I you can, hide them in walls, through attics and basements/crawl spaces or under carpets. Wall-to-wall carpet is acoustically excellent, and a thick felt or foam underlay can be sliced to hide a multitude of wires. Flat wires are available for running up walls. Double-check the polarities (red and black) of connections at the amps and at the speakers: a reversal damages both sound and imaging.

Where do we put the listeners? Just as for a loudspeaker, the worst seat is in a corner. The best seats will be a few feet out into the room – experiment while listening to music. The common situation of the sofa against a back wall is unfortunate, as there is a strong likelihood of excessive or boomy bass, and poor imaging. Equalization, or moving the subwoofer, can help the bass problem. Imaging can be improved by placing some sound absorbing material behind the head, e.g. a thick fabric wall hanging, some fabric covered fiberglass board, or even some cushions will do nicely. The wall behind the head is like a big acoustical mirror – not a good idea.

Now, we are almost done. We need to aim the speakers so that the best sound gets to the important seats. Most good speakers have wide enough dispersion to cover large horizontal angles, but others don't, and some are like acoustical flashlights. Get someone to angle the speakers while you listen, or move yourself around. A recording of broadband pink noise is a good test signal. It should sound similar in the important seats.

None of this is very difficult but, like many things in life, a little extra effort at the beginning can pay off handsomely in long-term satisfaction. And the best thing of all is that most of what we have discussed costs little or nothing.