

Subjective Study Results

On November 13th a subjective study was conducted at the home of Drs. Lidia Lee and Earl Geddes. This study was blind to the subjects and semi-blind to the implementer (Dr. Lee knew what the speakers were, but not where they were placed or the purpose of the test). Four loudspeakers were evaluated in four categories. The categories were:

1. Spectral Balance
2. Spectral Smoothness
3. Bass Extension
4. Overall Sound Quality

The speakers that were evaluated were:

1. A GedLee prototype design - uses TAD drivers (1" compression driver and 15" woofer). This system used composite fiberglass cabinets with constrained layer damping construction throughout, a special waveguide and a patent pending refractive index waveguide plug, which reduces the Higher Order Modes (HOM) in the waveguide.
2. A JBL 4430 - somewhat outdated design, uses a diffraction horn with a 1" compression driver and a 15" woofer.
3. A Gradient Revolution - uses two dipole woofers and cardioid mids and highs. Claims to be a constant directivity design.
4. A GedLee production system – uses B&C drivers in the exact same enclosure as described above – different crossover and port tuning.

These are all high quality speakers, two having been proven by substantial market success.

The subjects were presented with noise, a piano scale, and a vocal piece in a round robin presentation, after which each speaker was played for 10 more short passages of various musical passages – all selected from the DLC LIT test disc. After each set of subjects the speaker locations were changed for the next set. The listeners rated each speaker on a scale from 1 to 5 where 1 was labeled “inferior” and 5 labeled “superior”. A 3 was labeled as competitive.

In general the responses were widely divergent and as such, statistically, there was probably not a clear winner, but there was a clear loser - one speaker that could be rated as “inferior”. That was the JBL 4430. This should not be surprising and is no reflection on JBL, its just that this is a rather old design and many improvements have been made since. From the data the other three were quite close and the top two were virtually indistinguishable.

The data came out as follows:

Source	Spectral Balance		Spectral Smoothness		Bass Extension		Overall Sound Quality	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
GL(TAD)	3.1	1.0	3.0	1.1	2.5	1.1	2.9	1.2
JBL	2.4	1.0	2.1	1.0	3.2	1.0	2.2	1.0
Gradient	3.5	1.2	3.4	1.2	3.0	1.3	3.5	1.1
GL(B&C)	3.6	1.0	3.2	.9	3.0	1.0	3.3	.8

A composite sum of the four parameters was tried, but this did not alter the ratings from the overall Sound Quality Numbers to any significant degree.

The results indicate that the GedLee B&C system was not statistically different from the Gradient system. The only truly statistically different speaker was the JBL which faired poorly. The JBL was used as an example of the classic place that horn systems have historically held in a sound quality comparison to high end loudspeakers. This last point gives strong evidence for one of the central questions of this study. That is, given that the sound quality of conventional horns, which is well known as being poor, does the new GedLee approach correct this situation, thus placing a compression driver/waveguide combination on par with a high end audiophile system. The answer appears to be yes.

The second interest in this study was whether or not subjects could detect the difference between a high end driver solution and a high value one. While it is somewhat doubtful that the subjects had a clear preference for one over the other GedLee designs, it is clear that the extra cost of the high end components is hardly justified. Beyond brand recognition there appears to be little advantage to the far more expensive components.

Of particular satisfaction was the fact that the GedLee B&C had the lowest standard deviation of responses in all categories. A survey of the responses showed that no one did not like this system. This was true only of this system. All other systems had someone who didn't like them. So while it was virtually tied with the Gradients for the best overall sounding system, it was far more consistently rated as high quality.

This write-up was based on the first cut of the data. There are other things that can be done, such as to normalize the responses. When summed across all responses, there was a wide difference in this sum meaning that some were more negative about the group than others. This would make the responses of the negative group less important than the responses of the group who tended to rate everything high. The data could be normalized so that all respondents had the same mean rating. This would be fair since the speakers were to be rated against one another and as such the mean rating should be the same for all respondents. Another way of saying this is that each respondent was given a certain number of "quality bucks" to spend and that they must balance out this expenditure across the speakers until they have spent all their "bucks". This requirement can be easily enforced on the data by making the mean expense across subjects the same.

All in all this test was found to be quite satisfying with the exception of the incredible time that it took to set up and perform. However, this type of blind testing is the only way to get valid data in a test like this. If the subjects could have seen the loudspeakers, it can practically be guaranteed that the gradient would have won, hands down. It looks like a high end speaker and as such people would rate it that way. Many listeners just don't like "horns", because, quite honestly, they have a reputation for sounding bad. Listeners would then have rated any of the horn systems

as inferior. If it had been explained that the refractive foam made the waveguides sound superior to standard horns, then we could rightly be accused of trying to sway the results and we would not have gotten an honest appraisal.

The room was strongly criticized as being too live, and that it is. But this very live aspect highly accentuates many design flaws in a loudspeaker. A very dead room only evaluates the response along the line of sight to the driver. Since live listening rooms are advocated (although not as live as the test room) it is natural to look for a worst case scenario in this regard. Since these were all controlled directivity loudspeakers and all in the same room, this technique was fair to all of them. All of these speakers would sound better in a somewhat less lively room, like our home theater. we could not have performed this test in that room owing to the space limitations. In another month or so there will be three channels of these speakers in the theater and they will be available for audition.

These results were completely in line with our own personal perceptions and we would have rated these systems almost exactly the same as the results came out. We have had the chance for extensive listening on all the systems except the Gradients. We prefer the B&C system to the Gradients, but we're hardly unbiased in our perceptions. We have had the B&C systems in several rooms and have listened to them for many hours. They are exceptionally transparent and the refractive waveguide offers a high end sound quality unlike anything that we have heard before. They are completely non-fatiguing, partly because they simply don't seem like they are even there. There is no harshness to the sound whatsoever. We are quite pleased with these results and they have encouraged us on to the next step of finding a market for this product.