

Biology of Home Entertainment

By Darren Springthorpe

For us mere mortals to enjoy a home theatre we need to use two of the biological senses we were born with. I find it most interesting, that few of the people I speak with have an understanding as to the importance of each sensory stimulus, and how the balance of those senses affect the level of enjoyment we could expect to receive, from our new and expensive home theatre system.

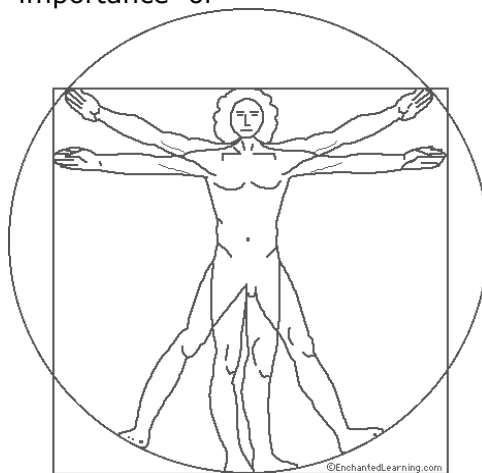
If you are reading this article then it is likely you have been bombarded with conflicting information from Manufactures, Brands and Labels, bulk retail chain stores, the internet and even friends and family. So who can you trust?

What information, if any, is useful to make your buying decision about screens and screen technology, sound and sound technology? **Let's first look at the sense that we will rely on to make our decision, the sense of sight. This is also true when making a buying decision about sound equipment (we use our eyes to tell us what it sounds like, strange but true)**

The more time I spend in the domestic arena of entertainment the more concerned I become about the information the so called HIFI shops tell the unsuspecting buyer.

In this installment I attempt to clarify some long held beliefs, and very misleading assumptions people make to the detriment of their enjoyment of the investment and performance return of Home Theatre.

The first thing to keep in mind while reading, we are Analogue beings, we see analogue wave forms of light, we hear analogue wave forms of sound, and to achieve the best results for the budget it is wise to understand the way we see and hear and how much we see and hear.



Whether the source information is DVD Blu-Ray, digital audio in the form of CD or analogue in the form of Vinyl there can be massive improvements in our enjoyment if we just apply a few simple laws of physics that compliment the biology of being human.

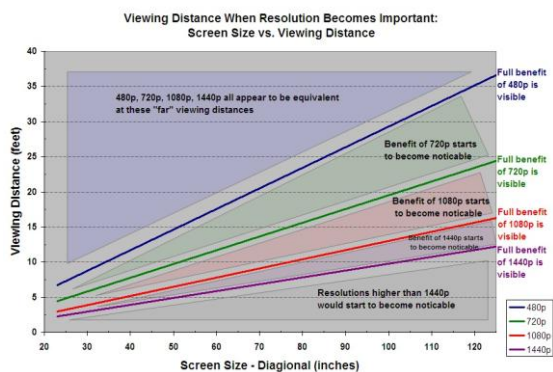
The Sense of Sight

Sight, out of all the senses, is the least developed sense at the time of birth. At about seven months of gestation, the eyes have matured, and the critical nerve connections to the brain are completed, only bright light can filter through the abdominal wall and amniotic fluid. It might be like looking at the world through frosted glass, the image is all diffused.

At birth, vision is so poor, that it approaches the edge of legal blindness. Also at birth, the retina lacks the ability to distinguish details and textures. When a newborn looks at hair,

the newborns eye doesn't get a sense of the individual hairs, but just a sort of generalized, uniform color. Newborns are not, as was long believed, color-blind. Within about four months, babies are able to distinguish all colors. Generally, by about 8 months of age, a baby can see almost as well as an adult. However the normal development of vision depends greatly using the eyes during the first two years of life.

The Human eye's limitations are biological, from birth to old age it is the limiting factor of what we see. Understanding how eye's and how we see works is an invaluable foundation to help in making the right choice of screen for you.



As shown in the above table there is a relationship: distance to resolution, view anything from outside of this relationship and the resolution becomes an irrelevant issue.

The debate about resolution capabilities of the screen, such as 1080P is old and will only get worse as we start to see newer generations of display screens boasting 2160P. The resolution of 1080P relates to the number of pixels on the screen not the quality of the image displayed. The scaling capabilities of the video processor determine the qualities of the image displayed, this will also be the case in the very near future when 2160, 2K: 4K resolution become readily available.

The Suffix I or P relates to how the image is displayed I=interlace P=progressive scan but we already know all of this.

Manufacturers want you to buy their set. In order to convince you theirs is better, tricks are used to "look better" than the next competing brand. One trick manufacturers use is picture level settings, often set as high as possible without damaging the set.

So what? You say all I want is a home theatre. Now let's look at how we can make a decision based on the biology of sight and sound? And for ease of incorporating a budget lets use a nice round figure of \$10,000 and let's for example say we want a home entertainment system with the lot just to keep things interesting.

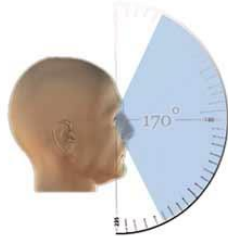
What follow won't be brands, makes, models or "specifications" as that would require the need to rewrite this article every 6 months, just to stay behind the eight ball, let alone get in front of it. For this we need to look at formulae, these formulae need to work regardless of budget, room size and any other variable that may crop up.

These formulae have been tested over the last ten years, and have proven themselves time and time again. So what are these magic formulae you say, and why have I never heard of them before now. The answer is simple, unless you have had direct dealings with the author of It's About Performance and this article, the formulae have simply not been in the public forum until now. For us to understand the formulae we need to understand the ratio of Visual cues to Audio cues in real terms as in the natural environment.

We then need to apply that same ratio to the performance ratio we want to achieve in home theatre. As Home Theatre participation is passive, it is important to maximize the audience involvement cues, from both the visual stimuli and the audio stimuli, to simulate that of the natural world. We know what is happening behind us, due to what we hear not what we see.

When we design systems with the ratio of biological understanding, as described above, using the following images, this ratio perspective, of vision and audio becomes crystal clear.

Once we recognize our field of view as being 170° on the vertical and roughly 200° on the horizontal, (if we take into consideration the full peripheral vision) then we can easily appreciate that our visual cues make approximately 40% of the information we have going on around us, the balance of which comes from the auditory cues.



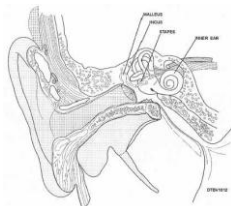
Knowing that our field of view is approximately 40% then it would stand to reason to

allocate 40% of our budget to the vision products we need for our home theatre, thus giving the remaining 60% to the audio system. Now if we investigate further this ratio begins to look not just sensible but more like a light globe moment. AAAHHHH!

The Sense of Hearing

Hearing develops as early as 12 weeks in foetal development, the 3 bones that make the inner ear, **ossicles, malleus** and **incus** are fully developed the cochlea and auditory nerve centers are completed and our sense of hearing is fully functioning at birth, and is said to be in the order of 20Hz-20 KHz.

As with sight, our sense of hearing diminishes with age. Recent studies have shown, some age related hearing loss, can be attributed to vitamin D deficiency as the bone density relies on calcium, which is influenced in take up by vitamin D.



The human auditory system is binaural and spatial hearing is a function of the relationship of time over distance. As sound takes time to enter both left and right ears, the difference is calculated and we are able to pinpoint the direction of the sound within a few degrees of accuracy.

As we hear in the natural world, a 3 dimensional sound field, the goal of surround sound is to reproduce a 3-D sound field in the audio tracks to maintain and engage the audience, while enjoying a movie; the sound field must balance and compliment the visual cues on screen.

Normally, we hear sound from all around. The human auditory system can discern both the location of a sound and its distance from a listener.

This is easily achieved in a 4.26-meter-diameter geodesic sphere, inside an anechoic chamber, (as shown in image). The sphere contains 277 loudspeakers, and can present 16 sounds simultaneously from selected or all locations, simulating complex real-world auditory environments. (Ultimate in surround sound.)



Many so called innovations of the latest and greatest surround systems rely heavily on equalization programs to setup and "calibrate" the speaker system to the room. In order to do this a microphone is supplied, we then remain silent while the onboard computer of the amplifier/receiver goes about its business. Some will say this gives a better result, but they may not be aware of the biological capabilities of the human ear.

Following table shows the differences of performance, from that of the naked ear, to that of a high priced, and well balanced Electro Condenser Microphone system (ECM).

Characteristic	Good ECM system	Human hearing
Source location accuracy	Within 1-5 degrees	About 2-5 degrees
Ratio of highest to lowest frequency (bigger the better)	20 : 1	1000 : 1
Ratio of strongest signal to weakest (the bigger the better)	Million : one	32 trillion : one

Human hearing is a superior auditory system in every respect, except, possibly source location accuracy. A clear display of disparity of performance, and one could easily argue the benefit of natural calibration in the form of system design and component matching. Utilizing the harmonic characters to blend the individual components that make up the system, the whole is greater than the sum of the parts?

The reliance on electronic means of calibration as the sole method of determining the performance of an audio system is clearly limiting the potential for full audience participation.

To consider the biological, and the physics of performance, regarding the audio and visual requirements of home entertainment, application of the formulae of 60%-40% lifts the level of performance of both the audio and visual. Allowing, \$6000 for the audio components and \$4000 for the visual components, the balance of performance for both sight and sound stimuli, the cues for audience participation and involvement closely resemble that of the natural world environment.

The level of both the audio and visual performance resembles a system performance of 20%-30% higher in cost, and who wouldn't want that? Simply by addressing the laws of physics of the rooms requirements and the human biology of how we hear and what we see. Performance has little to do with how much one spends and more to do with where one invests their budget.

Just as many a composer will attest, the ability to induce **a specific mood response from an audience can be achieved with sound too a much greater degree than with visual stimuli alone.**

As Phillip Glass once said, the visual image has no correlation to the emotive response in the audience it is the sonic progression of the musical score that evokes the emotions, joy, or tension that connect the eye/ear, and ultimately create the desired emotive response in the audience.

Assessment of the biological formulae, 60/40 and application of formulae to the allocated budget, provides greater performance, the differences become clear, we rely on each sense for specific cues, the key is to maximise the cues, so the involvement of a passive audience participation, is at least at a level of balance with that of the visual cues, if the follow statement is true a picture tells a thousand words, then it would stand to reason a sound engages a thousand emotions.

Discover a world of performance difference first hand, reality home theatre at its best. Make an appointment, at Audio Trends and speak to quite possibly the most experienced team in the country.

**Audio Trends Showroom 10 Argent Place,
Ringwood, VIC 3134**

Phone 9874 8233

Hours: Mon - Thurs 10am to 5.30pm

Fri 10am to 7pm, Sat 10am to 4pm

