

**3D's "Immersive Experience" at Home:  
Why the home 3D experience will Not Rival that of the Theater**  
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**Introduction**

The question has been raised again recently whether 3D in the home could rival or potentially supplant 3D in the theater. 3D in the home has some interesting possibilities but can it rival the immersive experience in the theater?

Motion picture producers and theater owners have a significant opportunity before them given the recent success of movies like G-Force. Can this opportunity be extended to the home in a meaningful way? Yes. Can 3D in the home eclipse or even rival the theatrical experience? No, but they will be complementary to one another.

Generally how close one sits to a screen affects one's tolerance for aggressive 3D. In a theater, where one normally sits well back from a screen, most people can tolerate fairly aggressive 3D. By aggressive we mean too much positive parallax held for too long or too much fast panning motion in depth. Both of these conditions are unnatural to the eyes and brain and may cause a series of issues with viewer comfort.

Yet when one sits 6 to 7 feet from a screen (i.e., typical sitting distance for home theaters) that same material would quickly become intolerable.

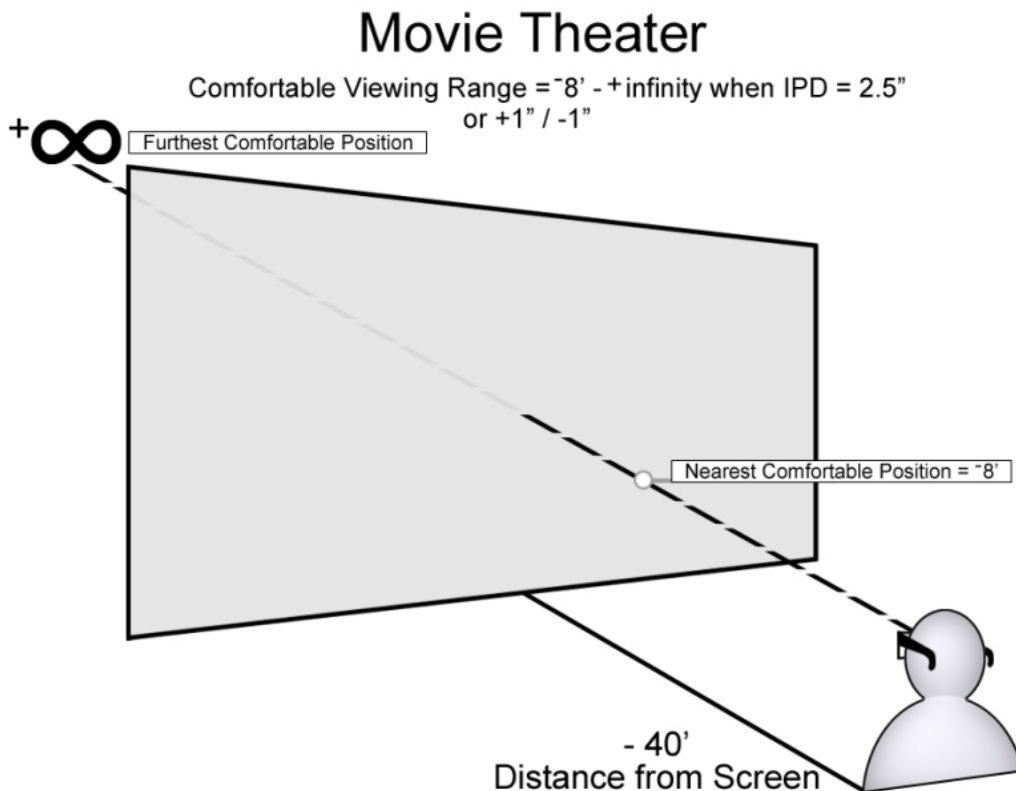


Chart 1 shows schematically the typical level of 3D aggressiveness that most theatergoers seem to enjoy. Comfortable 3D ranges from about 20% of the distance from the viewer to the screen to infinity. (See In-Three's web site for how we quantify 3D impact.)

## Home Theater

Comfortable Viewing Range =  $-1.8' - +10'$  when IPD = 2.5"  
or  $+1'' / -1''$

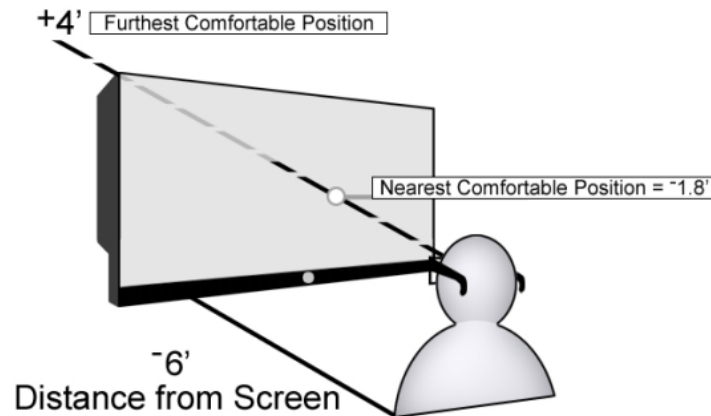


Chart 2 shows the typical range of 3D appropriate for a home theater. Note that for 3D to be comfortable on a home screen it must be compacted toward the screen – from about 30% in front of the screen to about 65% beyond the screen.

If this holds for most people, as both testing at In-Three and testing at Berkeley so far indicate, then viewing 3D at home will be more akin to a “snow globe” view of the 3D material than the immersive experience that most theatrical presentations allows.

This article attempts to explain why.

### **First some background: Left/right eye separation, i.e., parallax**

Depth in or out of the screen is created when the left eye and right eye views cause viewers' eyes to cross at a point in front of or behind the screen.

Adult eyes are, on average, separated by about 2.5 inches (65mm).

Now think about looking at a ball on a screen when the right eye's view of the ball is 2.5 inches to the left of the left eye's view of the ball (negative parallax). When exposed to viewers with a proper projection system, each image will cause each eye to track the ball independently, crossing at one half, or 50%, of the way to the screen. (If you question this, sketch the scene looking downward to see its geometry.)

On the other hand, if the ball in the right eye's view is 2.5 inches to the right of the ball in the left eye's view (positive parallax), the axis of the eyes' vision will be parallel. In this case the ball will appear to be at infinity -- just like when you look into the distance.

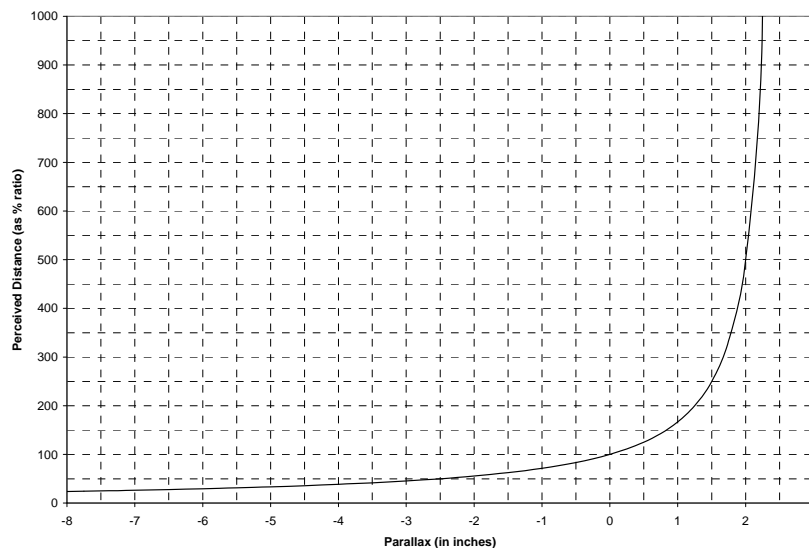
Normal eyes do not ever diverge apart. Therefore, if you see positive parallax on the screen exceeding 2.5 inches, be aware that the scene will be creating an abnormal and difficult viewing experience, and one likely to cause discomfort.

Similarly, if the negative parallax exceeds 10 or more inches, the scene is presenting objects at or closer to you than 20% of the screen distance. That also may be very difficult to view for any extended length of time.

## Comfort Zone

As hinted at in the previous paragraph, an important concept in understanding the impact of 3D material is the audience's "comfort zone". This is sometimes called "Percival's Zone". It is the limit of separation that allows the audience to "fuse" – or view comfortably – the stereo images. Remember that the viewer's eyes are focused on the screen but converged in front of or behind the screen. So, too great a disparity between focus and convergence will begin to wear out the audience as the brain tries to direct converging and focusing muscles to the same point in space.

As mentioned above, the size of the comfort zone is related to how close the viewer is to the screen. How close the viewer sits is related to the screen size. A viewer sits closer to a home screen than a movie screen. Therefore the comfort zone on a home screen is narrower than on a movie screen. (Also, a child's comfort zone is narrower than and adult's.)



Generally we find in our testing at In-Three that the comfort zone for the distance theater viewers sit from the screen is about negative 10 inches to positive 2.5 inches or about 12.5 inches. For the typical distance between a viewer and a home screen (about 6-7 feet) the comfort zone is about negative one inch to positive one inch. (These inferences from our testing are supported by the work done at Berkeley by Martin S. Banks, PhD,

Professor of Optometry and Vision Science; Affiliate Professor of Psychology and Bioengineering.)

Our interpretation of these physiological constraints is that the home 3D experience will be quite pleasant and in many cases certainly exciting (e.g., the Super Bowl). However it will not replace the very different immersive experience of watching 3D in a theater.