PERSPECTIVE and VIEWING DISTANCE

What do we mean by visual perspective? It's the appearance of depth when a 3D scene is represented by a 2D photograph
Consider this scene.

If we zoom in we will get an image like this:

But if we just enlarge the same section from the first picture of the scene the 2 images are the same.

Why is this? It's because there has been no change in perspective. This is why zooming always looks unnatural.

What gives us a 3D image? What gives depth to our views? How do we judge distances and spaces? What visual clues do we use to judge how far away, for example, a tree is? Having two eyes gives us parallax but a one eyed person can still judge distances. Size is one thing we use. We have a good idea how big trees and people are. Converging lines help. Railway lines, for example, appear to meet on the horizon. Distant hills appear lighter and hazy, objects become unclear.

It was not until 1420 that an Italian architect Brunellechi used maths first to define perspective. In 1435 the painter Alberti used it in pictures and is credited to have first defined vanishing points. Before then early painters struggled to get perspective correct.

An example of an early picture with incorrect perspective.

An example showing strong perspective.

But what effect does perspective have when we take pictures? And how should we use it?

When we track in with a camera we have a change of perspective, This change is much more natural than zooming, which gives us no change of perspective. When we want to have a closer look at an object we naturally move nearer. Our eyes do not have the ability to zoom!

If you were standing in this park and looking at these trees this is the perspective you would see. We can call this standard perspective, A 75mm lens on a digital SLR camera would give you this perspective.
Try this by looking through the view finder of a SLR camera with a zoom lens, with one eye, keep the other eye open and adjust the focal length of the lens by zooming. The two images will eventually 'line up' The focal length of the camera lens is producing the same image size as your eyes.. On a camera with a fixed lens this would be called a standard lens.

Notice the distance between the trees in the above picture.

If we then walk forwards but change to a wide angle lens, one with a short focal length, the perspective would change and the distance between the trees appears to have increased. So if we use a wide angle lens, rooms appear larger and distances appear greater.

If we move away from the trees but use a narrow angle lens, one with a long focal length, the distances between the trees appear shorter, rooms appear smaller and a cricket match on TV the stumps appear to be quite close.

So a lens that is wider than a ‘standard’ lens is a wide angle lens (having a shorter focal length) and a lens that is narrower than the ‘standard lens’ is a narrow angle lens (having a longer focal length)

We should be careful when deciding what focal length lens we use when making our pictures. Do we want the scene to look ‘normal’ or do we want it to look large? So a choice of lens is important. Of course the focal length of the lens will also affect the depth of field.(D.o.F.)

A lens with a short focal length will a have a large D.o.F and lens with a long focal length will have a small D.o.F.

Consider this picture. We are shooting a discussion between two people in a park. We shoot the 2 shot first, then the close-ups.

Then when we cut them together they match.

But if we shoot one of the close-ups on a lens with a long focal length,

the background appears out of focus and it looks as if the man has moved further away from the background so the two close-ups no longer match.

Viewing Distance for watching TV.

It might appear that viewing 2D pictures from different distances would have no effect on perspective. In pictures with strong perspective clues viewers can change the apparent perspective by changing the viewing distance.

For example in the picture of the tunnel, by moving nearer to the image you do get a change in perspective, the end of the tunnel gets bigger, as it would do if you where moving near to the end.

Look again of these two pictures. Viewers would assume that they were taken from the same position But if the perspective in the second picture appears normal, the stronger perspective in the first appears abnormal for what is assumed to be the same object distance. Viewers can make the first picture appear to have less strong perspective by reducing the viewing distance. The so called ‘correct viewing distance’ is **equal to the focal length of the lens of the camera, or focal length multiplied by the enlargement.**

If we take this image using a digital SLR camera with image (CCD) size **23.7mm x 15.5mm** using a standard lens, 75mm, and then enlarge it **7.5 times** the image size will be **177.75mm x 116.5 mm**.   If we then view the image in the **same place** as the picture was taken and in order to get the image to line up with the real trees we will have to hold it at a distance **7.5 x 75 mm= 562.5mm** or 56.25cms.

This picture illustrates what you would see, but because the camera could not focus on the image and the trees, because of the short D.o.F., only the picture is in focus. With your eyes both would appear in focus.

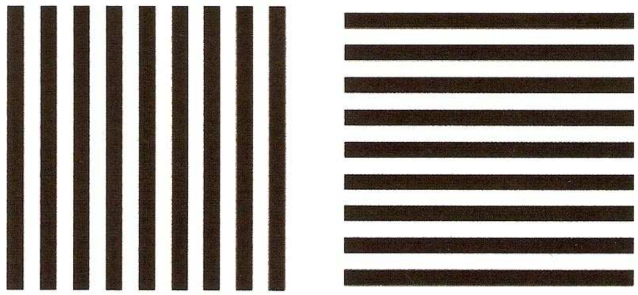
But if we enlarge it only **3** times, the image size would be **118.5mm x 77.5mm,** then we would hold the image nearer for the image to line up with the trees. **3 x 75= 225mm or 22.5cms**

Most 16:9 TV cameras have a CCD of **12.26mm** wide by **6.6mm** high and to produce ‘normal’ perspective we need to use a 35mm lens. So in order to view the images with correct perspective on a display with a of height of **330mm** we would have to enlarge the image 50 times so we would sit **50 x 35= 1,750mm** or **1.75 meters** from the screen to view the correct perspective.

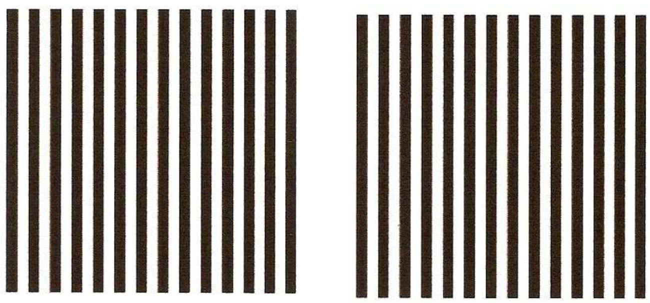
Resolution.

The human eye can resolve detail as small as 0.2mm at a distance of 1 metre, or one minute of arc. There are 360 degrees in a circle and 60 minutes of arc in one degree.

This can easily be proved if you pin the test pattern below to a well lit wall and view it from a distance of 10 metres you should clearly see the difference between the gaps 3mm, but the gaps 2mm can barely be seen.
But it needs to be printed out so that the boxes are 4.5mm by 4.5mm.



P4_Fig. 1: 3mm



P4_Fig. 2: 2mm

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But you can see that by moving nearer to the chart you will be able to see the 2mm lines, just as by moving nearer to a TV set or a cinema screen you will be able to see a less sharp image.

The lines with a gap of 2mm equate approximately to the 1080 line picture make up of HDTV.

But because of course the viewer does not concentrate on only one part of the picture and because the picture is moving this in reality would increase to 0.3mm at a distance of 1 metre.

So if every line in our 1080 line HDTV picture is 0.3mm high our screen picture height of HDTV, would be **1080 x 0.3mm = 324mm** or **32.4 cm.** to see a ‘line free’ picture at 1 metre.

Many broadcasters and TV equipment manufactures have used the formula of minimum viewing distance of 3.16 x picture height.

With a TV of 32.4cms high this would work out as **32.4x 3.16 =102.3 cms or 1.02 meters.**

For a TV with picture height of 324mm and by moving to a distance of 1.75metres the viewer would perceive the correct perspective if shot on a 'standard lens' and a better high definition picture.

As everybody's eyes are different there is not an exact distance to view the TV set, so the above examples just show the range of distances in which we can view the TV.

This of course is only theory. Most programmes made with TV cameras are not shot using 35mm lenses and often with different format size cameras. But this give us a basis for deciding on how 'sharp' our images should be and what our 'standard' viewing distance should be.

Graham Reed. Lighting Director. D.o.P

www.grahamreedlightingcameraman.com.

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