Perspective Compression by a Telephoto Lens: A Myth

> *"Apparent perspective is a term used to describe the apparent distance between objects in the foreground and objects in the background in a photograph. Lenses wider than 35mm will noticeably exaggerate the distance between objects in the foreground and objects in the background in your photograph."*
>
> *"A telephoto lens not only magnifies the subject, but it also tends to compress perspective and provides a sufficiently narrow angle of view to isolate a single building, provided you have sufficient altitude or you remain at a given altitude but shoot relatively far away from the building. The perspective compression characteristic of a telephoto lens makes distant background objects appear closer to your subject and in a more similar scale."*
>
> *"Simply put, a telephoto lens "brings subjects closer", while a wide angle lens seems to make subjects appear further away than they actually are. The result is a compressed and expanded perspective, respectively."*
>
> *"Telephotos are great for picking out interesting details from a landscape, such as natural textures and patterns to produce semi-abstract images. They also inherently compress perspective so things in the distance look closer than they actually are."*
>
> *"Everyone is accustomed to seeing wild animals photographed with a shallow depth of field and compressed perspective. These characteristics of long lenses are expected."*

Here's a fact --- long lenses do **not** compress perspective. They do **not** magnify background objects relative to foreground objects to give the illusion of reduced separation. You can **take advantage of** perspective compression and record it on film using **any** lens, but the compression has nothing to do with the lens itself.

The above quotes are typical of the misleading information available in numerous resources that offer photography "tips and techniques", including the internet, magazines, and books. Is it simply poor communication or is it a genuine lack of understanding by the writers? It's both. Most experienced photographers understand lenses and perspective, but too often use sloppy language that conveys the wrong message. Less experienced photographers accept the message at face value and pass it on to others. And so it goes. Miscommunication breeds misunderstanding and perpetuates a myth.

It's easy to dispel the myth by means of field tests using various lenses. It's even easier to do so by applying basic lens theory, as below.

Figure 1 shows two objects, with heights H_1 and H_2, at the distances s_1 and s_2 from a thin lens of focal length f (assume that s_1 and s_2 are much greater than f). Their corresponding images at the film plane have heights h_1 and h_2. Note that the lateral separation of the images has been exaggerated because of scale distortion. Images of distant objects should fall on nearly the same plane.

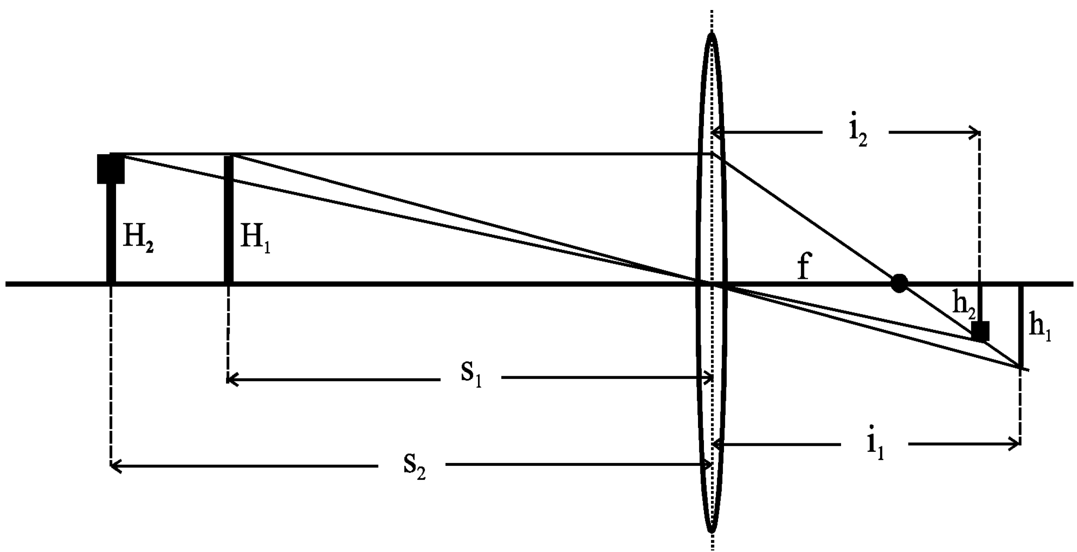

Figure 1.

The object and image distances are related by the thin-lens formula:

$$\frac{1}{s_1}+\frac{1}{i_1}=\frac{1}{f} \qquad \Rightarrow \qquad \frac{i_1}{s_1}=\frac{f}{s_1-f} \tag{1}$$

$$\frac{1}{s_2}+\frac{1}{i_2}=\frac{1}{f} \qquad \Rightarrow \qquad \frac{i_2}{s_2}=\frac{f}{s_2-f} \tag{2}$$

By similar triangles,

$$h_1=\frac{i_1}{s_1}H_1 \qquad \text{and} \qquad h_2=\frac{i_2}{s_2}H_2 \tag{3}$$

Substitute from (1) and (2) into (3), getting

$$h_1 = \frac{f}{s_1 - f} H_1 \qquad \text{and} \qquad h_2 = \frac{f}{s_2 - f} H_2 \tag{4}$$

The image height of the more distant object relative to the image height of the closer object is

$$R = \frac{h_2}{h_1} = \frac{s_1 - f}{s_2 - f} \tag{5}$$

where, for convenience, we have assumed that $H_2=H_1$ (as in the figure). Since s_2 is greater than s_1 (by definition), it is clear from (5) that R is always less than 1, i.e. the more distant object appears smaller on the film. The figure shows this geometrically.

It also follows that if the focal length f is much smaller than either s_1 or s_2, then **the value of R is not sensitive to changes in f**.

Conclusion: For all practical purposes, the relative image heights of distant objects are independent of lens focal length.

In other words, switching from a "normal" lens to one with a greater focal length at the same camera location will have no discernible effect on perspective.

So, what's "perspective compression" all about? It has to do with how you adjust to an increase in focal length. Because the longer lens has a smaller capture angle you tend to back away from your subject --- you want to see the whole building, not just the window. This, of course, changes perspective. See Figure 2.

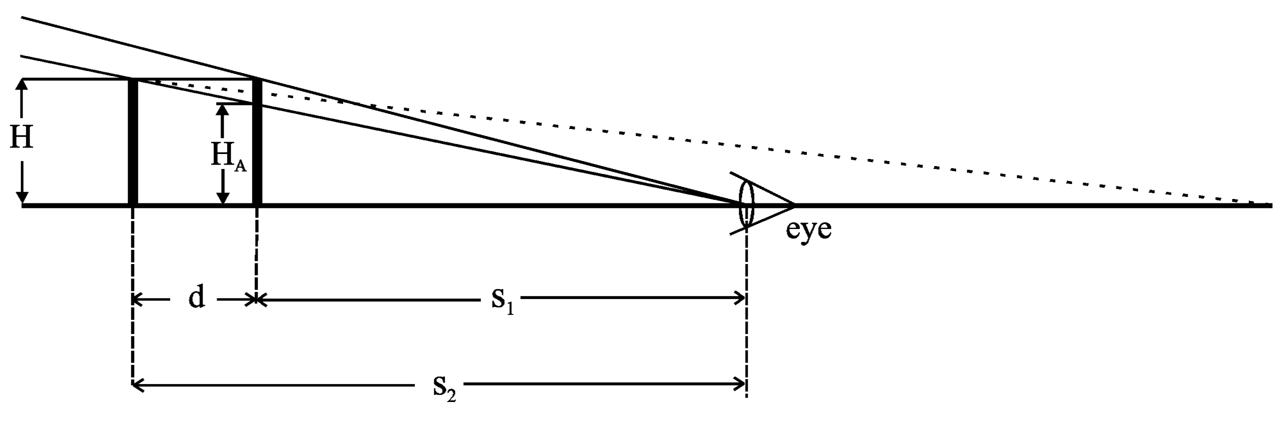

Figure 2.

Two objects, each of height H, are a distance ‘d’ apart. An observer is positioned at the large distances s_1 and s_2 (= s_1+d) from the near and far objects respectively. In the plane of the near object the apparent height of the far object is H_A, as shown. Relative to the height of the near object, the height of the distant object is therefore

$$R = \frac{H_A}{H} \qquad (6)$$

which, by similar triangles, is

$$\begin{aligned} R &= \frac{s_1}{s_2} = \frac{s_1}{s_1 + d} \\ &= \frac{1}{1 + \frac{d}{s_1}} \end{aligned} \qquad (7)$$

Because the denominator in the above ratio is always greater than one, the background object always appears to be smaller than the foreground object. However, as the viewer backs away the distance s_1 increases, thereby decreasing the denominator and increasing the ratio R. The apparent height H_A increases (see the dotted line). In other words, **the apparent size of the background object increases relative to the size of the foreground object!**

Perspective compression happens, but the lens doesn’t do it --- **you** do!