The Checker-shadow "Illusion"?

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The checker-shadow illusion is among the most striking illusions I came across in recent years. This is how it is presented on the site of Edward H. Adelson, the man who perfected it:

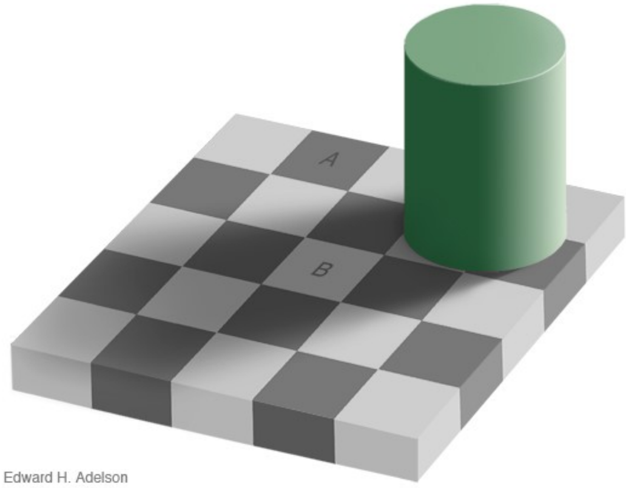

Figure 1: ***The squares marked A and B are the same shade of grey***

If, say, you cut figures A and B and put them next to each other, you would see that they are indeed the same shade of grey.

I would like to argue, however, that this illusion is wrongly interpreted, on Adelson's site as well as in the other presentations of it that I came across. To do that, I start with a few observations and distinctions relating to pictures. These observations and distinctions, which are not original with me, have wider application than just to the present case, and they can help clarify other issues relating to pictorial representation.

Let us look at some specific picture, say a photograph of Einstein:

Figure 2

We of course say that we see Einstein in the picture. However, the paper itself contains flat grey marks, which do not resemble Einstein in the least (for instance, Einstein had depth). We should therefore distinguish between the person we see in the picture, or more generally, the *object in the picture*, and the two-dimensional colour patches on the picture's surface by means of which the object in the picture is drawn. I shall call the latter the *projection* of the object in the picture on the picture's surface.

The object in the picture may be an image or a representation of someone real, as Einstein in the photograph above is an image of Einstein and a painting of Napoleon represents napoleon. But it might also be an imaginary person or thing, representing nobody. In addition, the object in the picture is sometimes identical with its projection, as in some Mondrian paintings. So additional distinctions can be made about pictures and depiction; but those already drawn suffice for the purposes of this paper.

Many things which are true of the object in the picture may be false of its projection. For instance, an object in the picture may be circular while its projection on the picture's surface is elliptical. Indeed, if we look again at the checker-shadow drawing, we can see that although the upper side of the cylinder is circular, its projection on the page is elliptical. Similarly, although A and B are squares, their projections are not squares.

That this is true of objects' shape and size is something we are all familiar with: we have all heard of perspective drawing. We also know that objects that have the same shape in the picture may have different projection shapes on the picture's surface. Similarly, objects that have different shapes in the picture may have identical projection shapes on the picture's surface. The first possibility is illustrated by the squares A and B in the checker-shadow drawing: while the squares in the picture have the same shape and size, their projections on the picture's surface do not. For instance, since square B—the square in the picture—is closer to us than square A, its projection's area is larger than that of A's. Notice that square B, the square in the picture, is closer to us than square A, but that the projection of square B is not closer to us than that of A. The second possibility is partly illustrated by the next illustration. (Only partly, because the different relevant objects in the picture have *different size*, *same shape* and identical projections; the more general case would be of different size *and* different shape but identical projections; I haven't found a nice illustration of this possibility.)

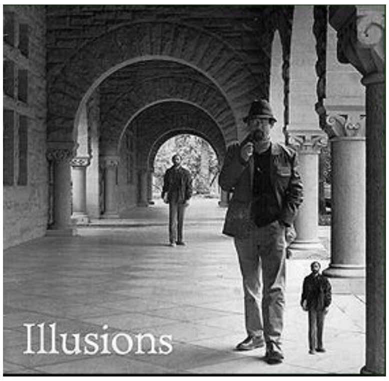

Figure 3

Since we are familiar with that fact about depicted objects' shapes and sizes and their projections', we would not be surprised if someone told us, say, that A and B are not squares; or if he told us that A and B are not the same shape. In fact, if we knew how to articulate the right distinctions, we would correct him and say that A and B *are* squares, and that they *do* have the same shape—that it is their *projections* that are not squares and do not have identical shapes.

Notice that occasionally it is easier to identify the shape of an object in the picture than that of its projection. To some extent, this is true even of A and B: they are squares, while their projections are only approximate parallelograms. Similarly, it is sometimes easier to notice that two objects in the picture are different size, while it is hard to say whether their projections are identical or not. This is clearly the case with the last illustration, where it is clear that the person in the front is much smaller than that in the back, while it is hard to say just by looking which of their two projections, if any, is larger.

What is not that often realized is that what is true of shape and size is true of colour as well. *The colour of the object in the picture need not be the colour of its projection.*

I shall discuss here just the case of brightness (alias lightness/luminosity/value). If two objects in the picture are exactly the same colour (meaning same hue, saturation and brightness), while one is in the shade and the other is not, then their projections will not be the same colour—their projections will at least differ in brightness. This is because while one object in the picture is in the shade, neither of the projections is. In normal lighting conditions, the surface of the picture is evenly illuminated. Similarly, objects that have different colours in the picture may have projections with identical colours. If one object is brighter than another yet it is in the shade, then their projections may have identical colours, brightness included.

This is indeed the case with squares A and B in the checker-shadow drawing. Unlike what is said in the caption under the drawing, the squares marked A and B are *not* the same shade of grey. Square A is darker than square B. The things that indeed are the same shade of grey are the *projections* of squares A and B on the picture's surface. If we talk about *squares*, as is done in the caption, then we are talking about the objects in the picture, not about their projections—the latter are *not* squares. And as it would be wrong to say that these objects in the picture have different shapes, it is wrong to say that they have the same colour or shade.

Accordingly, we are not under any illusion about what we see *in the picture*: we see squares in the picture, and they are *different* shades of grey. However, if we thought that it follows that their projections are square, or identical in size, or of different shades, then we were mistaken. Our surprise when we see the checker-shadow drawing for the first time is a result of two factors: first, our lesser acquaintance with the laws relating object-colour to projection-colour; and secondly, the confused and misleading way in which what we see is described. (It is possible that when perspective drawing was first developed, people were similarly astonished to discover that different objects in the picture are drawn by means of identical projections on the canvas.)

Does the checker-shadow drawing involve any illusion? It may, or does, in two ways, neither of which is the illusion it is usually said to involve. First, we may say that any drawing, painting or photograph of a three-dimensional object involves an illusion: what physically exists is a two-dimensional arrangement of lines and colours, while what we see is a three-dimensional object. In this sense, Einstein's photograph is also an illusion. But this is of course not the sense in which the checker-shadow drawing is said to be an illusion (nor do we usually call this an illusion). Secondly, we cannot normally see that A's and B's projection colours are identical, and, if we do not know about the relation of object-colour to projection-colour we may then be convinced that they are not identical. We are then under an illusion. But once our attention is drawn to this distinction, our attitude towards it becomes the same as that towards the object-shape – projection-shape distinction. And in the same way that it is strained to say that we have an illusion of seeing a circle where there 'really' is an ellipsis, it is also strained to say that we have an illusion of seeing different colours where there 'really' are identical ones.

The checker-shadow drawing demonstrates, in a way, our perceptual powers (as Adelson himself notes on his Explanation page, but for somewhat different reasons): we are right about what we see, namely the objects in the picture, which are the pictorial correlates of the three-dimensional objects with which we typically interact. What we find hard to identify, and about which we are often mistaken, are their two-dimensional pictorial projections—the shadows of our world found on paper and computer screen.