

**Our Mathematical Senses  
The Geometry Vision  
Prof. Vijay Ravikumar  
Department of Mathematics  
Indian Institute of Technology- Madras**

**Lecture – 03  
Bonus Material: Perspective in Visual Art**

**(Refer Slide Time: 00:14)**



The Tribute Money; Italy 1426 CE, Masaccio.

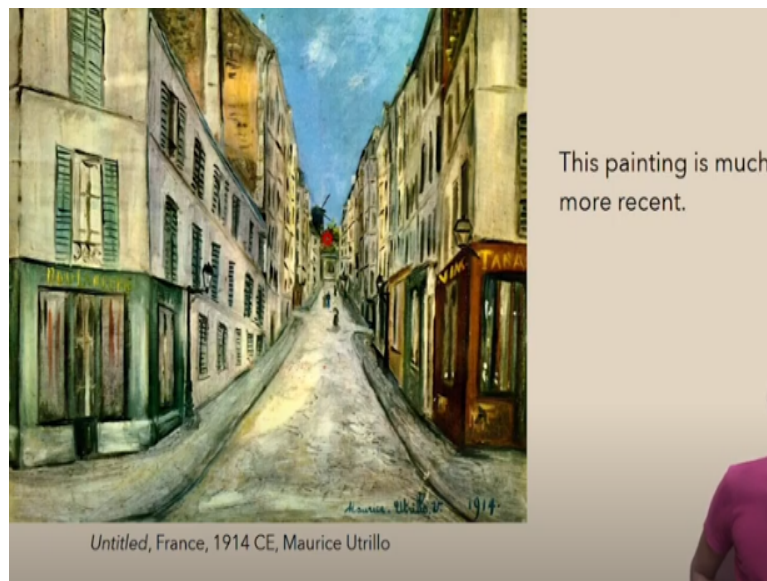
It's credited as one of the first paintings to feature linear perspective.

Hi, welcome back to the Geometry of Vision. In today's class, I would like to take a look at an old painting to get started. So this painting is known as The Tribute Money. It was created in 1426, in Italy. It is often credited as one of the first paintings to make use of linear perspective, which is why I want to take a look at it. Now how is it using perspective?

Well, we spent some time in the last lecture investigating vanishing points. And the fact that families of parallel lines in space appear to converge to a shared vanishing point in the picture plane. So we can see exactly that happening in this picture. We have a vanishing point, we have a line here, and a line here, and a line here, and a line here, all in the same family.

In space, all of these lines, even these stairs over here are parallel. And they all converge to a vanishing point, somewhere around this person's head.

**(Refer Slide Time: 01:32)**



So here is another painting, which is much more recent. And it also features a linear perspective and perhaps in an even more obvious way. This painting is untitled. But it is from 1914. So just a little over 100 years ago, in France. And this painting, as you can see, features a very clear vanishing point that everything is kind of converging towards.

The way that the painting is set up and framed, all of the lines that were presented are all converging, kind of bending up a little bit. So the artist is playing with it a little bit. But converging to this vanishing point here. It is really drawing us into that point. So this is another example of linear perspective in a much more recent context.

**(Refer Slide Time: 02:25)**



And here is a third painting somewhere in the middle. I do not know if you noticed that the first and second paintings featured one point perspective. In the last lecture, we talked about the distinction between one point, two point and three point perspective, in terms of how boxes and rectilinear objects are oriented with respect to the picture plane.

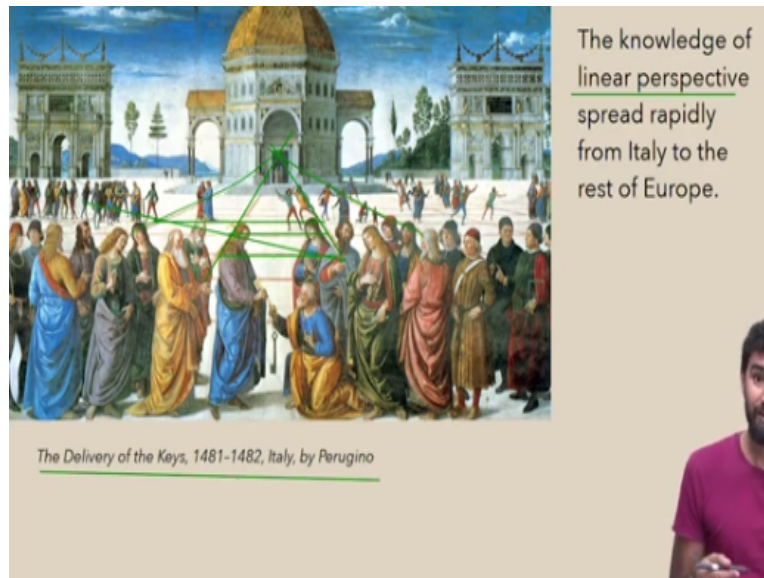
So this one actually features a two point perspective, because these tiles are oriented in such a way that both this direction, and this direction, which are independent directions or dimensions of the tiles are extending away from the picture plane, they are not parallel to the picture plane. This picture is by Vermeer and is in 1665, whereas the tribute money is 1426.

So more than 200 years later. Vermeer was also very known for creating very precise perspective drawings. So in this painting, if you were to extend these lines out, they will almost perfectly meet at two vanishing points. So I will attempt to do that here.

And we will see if it works. So let us try extending this line here and this line here. They should meet at the same point at infinity. But of course, I am not using a straight edge right now. So it is a little bit imprecise. But if you were to try this with an actual straight edge and properly extend these, you will see that it lines up quite perfectly.

Which is maybe not so surprising given that this picture has a certain photorealistic quality, long before cameras. It really feels like we are looking at a photograph of this room, we could be looking at a photograph of a tiled floor. And which is quite impressive, given the time period that this was created in.

**(Refer Slide Time: 04:56)**



So clearly something happened in European painting during the 15th century. Once this knowledge of linear perspective was kind of popularized and written down and made precise, it very rapidly spread from Italy to the rest of Europe. So this is again a very famous early perspective painting from the Renaissance, which has a very clear demonstration of one point perspective of a square tiling.

So we spent some time looking at square tilings in the previous lecture. And you can see that if we extend these lines out, we get our vanishing point here. And can see that they are lining up quite well. And you can also see that the technique we talked about in the last lecture of finding the next horizontal line is also used.

If we extend these diagonals, they will actually tell us exactly where the next horizontal line should be. So the next horizontal line is here. So if we were to start with this horizontal line, we could find the next two, by using this diagonal technique. So that was also pioneered during the Renaissance by artists. So clearly, once this

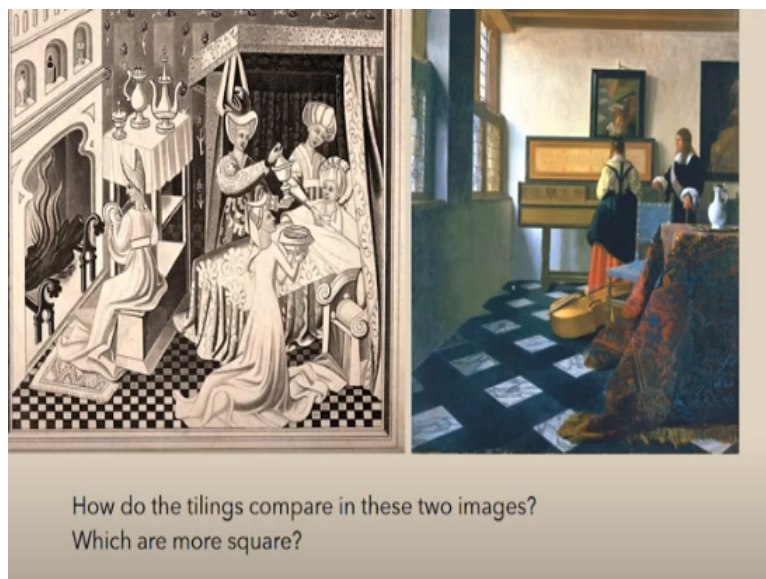
knowledge of perspective was kind of discovered, it quickly spread through Europe and greatly influenced painting in Europe.

**(Refer Slide Time: 06:44)**



Now for comparison, let us look at one other painting from England, from the late 1400s. So it is actually after or during the time of this painting, and definitely after the first painting we looked at. But in those days obviously, information traveled much more slowly. And the knowledge of linear perspective had not reached England yet in the late 1400s, when this painting was created.

**(Refer Slide Time: 07:15)**



So you can see that in comparison to the Vermeer, the tilings look quite different in the two paintings. So here is a question. In which of these two paintings do the tiles look more square? And it is actually a bit of a trick question.

Because in the first painting, in the painting on the left, which is the English painting, the tiles are literally square, I mean, they have actual right angles. And they are more or less square in shape. And they are very uniform. We can look at a tile here, and a tile here, and they are exactly the same shape. They have the same angles and the same lengths and everything.

So it is a very direct interpretation of a square tiling. In fact, it is as if we are taking a square tiling and just looking at a bird's eye view of it, at least from our modern perspective. So in that sense, maybe you would say the left picture has tiles which look more square. In comparison on the right hand side in the Vermeer, these tiles are not actually square at all. If we take any one of them, just highlighting a few of them.

None of the angles are right angles. As we go from one square to another, the lengths are changing, the areas are changing. It is supposed to represent an evenly tiled floor, but there is nothing even about it. And there is nothing square about the individual tiles when we take them in isolation like that.

But clearly, when we just view the painting, something in our brain clicks, and we know that this is supposed to represent and quite accurately represents in some sense, an evenly spaced square tiling. It kind of just takes us in and it feels realistic somehow. So somehow, they look to us like perfect squares. So there is something going on there. And from the last lecture, we know exactly what that is.

Vermeer is using a two point perspective. He is accurately creating, having these lines converge. These families of parallel lines converge to two different vanishing points.

**(Refer Slide Time: 09:50)**



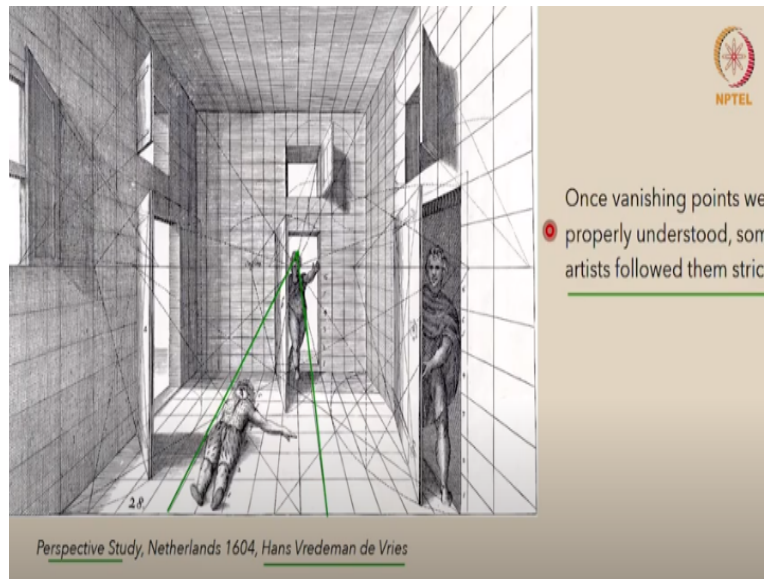
And whereas the artist on the left, the English artist who is not known, was not doing that. He was just taking what he saw, interpreting it and creating an image that actually, in a way, combines many different perspectives in one. So we might be viewing it looks like we are viewing this, top of this table from one perspective.

We are viewing this top of the bed from another, we are kind of looking up at the bed and down at the table. And it is actually, there are many different perspectives that are combined in one, which arguably is actually a better way of capturing or another more accurate way of capturing how we actually move about the world. Because we are not understanding the world through photographs.

We are understanding it by moving around and being immersed in it. So our experience of the world could, you might say, be captured more accurately by the painting on the left. But it is not tricking our brain in the same way as the Vermeer into thinking that we are seeing the tiling from an actual single fixed viewpoint.

So for better or for worse, the discovery of vanishing points, or points in infinity, forever altered the stories that artists told and also the way that they told them. So there is something about this English painting that is very much of that time.

**(Refer Slide Time: 11:11)**



And once vanishing points were properly understood, some artists followed them very strictly. So this is a sketch or a kind of perspective study from the Netherlands 1604, by de Vries, who actually wrote some textbooks, instruction manuals on perspective.

So a lot of his drawings are still used today to help teach or learn some of the fundamentals of two point perspective and three point perspective. So we can see in this example here, one point perspective is being used for sure, on the tiles on the floor. But there are actually many other vanishing points in this image as well.

It is actually a fairly sophisticated image, because not every line, not every straight line is parallel to this main family of lines here. You have one main family of lines, which is kind of determining one vanishing point, which is why I am saying this is in one point perspective. There is a vanishing point somewhere over here, which most of the lines are converging to.

But there are many other lines that he has created. So it is actually quite sophisticated. So for example, and thankfully, he is also marked out where those vanishing points are. So this is a very instructive painting to look at. Not painting but instructive drawing to look at in that way. So besides this main vanishing point here, how many other vanishing points do you see?

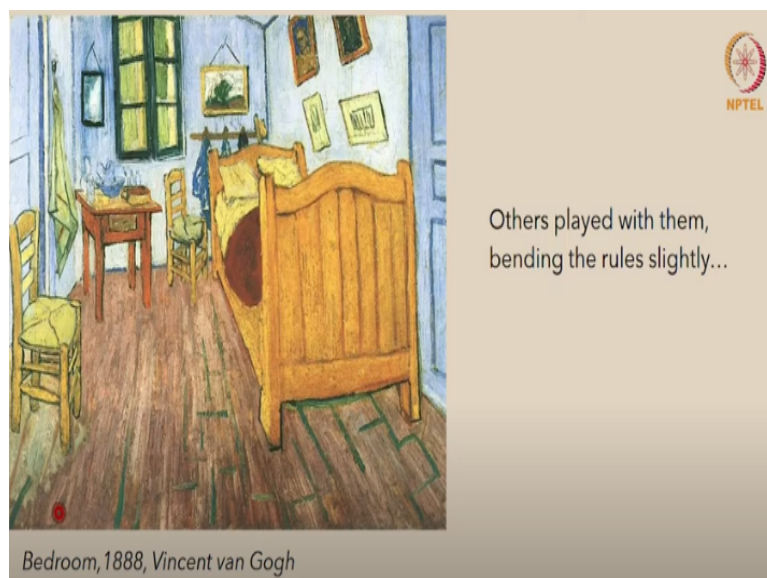


Well, almost every single one of these doors is giving us a new vanishing point. Because for example, these two lines are parallel, and they are converging to a point here. But this store over here is not at the same angle as this store here. So its top and bottom edges are converging to this vanishing point. And similarly, this store is giving us this vanishing point, this store is giving us this vanishing point, and so on and so forth.

So there are many vanishing points in this picture, which is supposedly in one point perspective. So that is also just something to keep in mind that when people use the terms one point perspective, two point perspective, it does not mean there is literally just one vanishing point or two vanishing points. It is more about the majority of the shapes in the painting, are they converging to one or two.

However, the majority of the rectilinear objects are oriented with respect to the picture plane. So let us, going back to the main point, this is just an example of how many artists took, were very fascinated by perspective and fully absorbed it and used it very carefully to create these almost photograph-like images long before there were cameras.

**(Refer Slide Time: 14:16)**



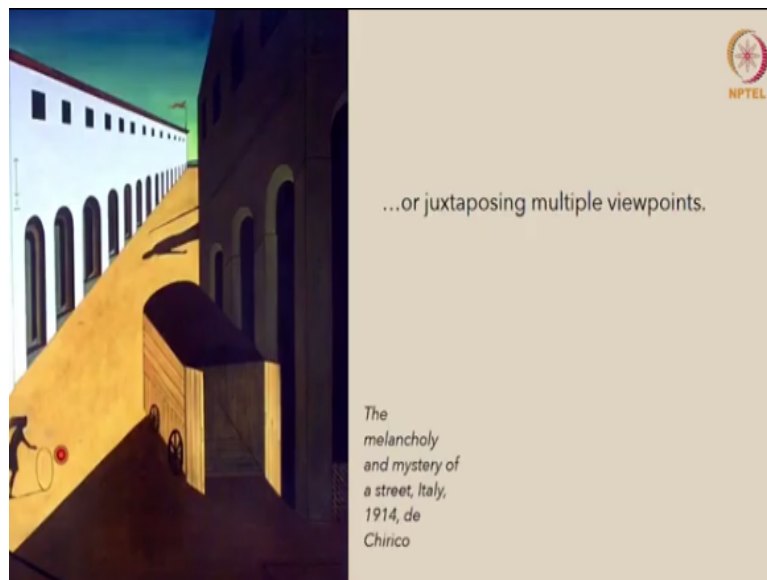
And on the other hand, many other artists began taking in these ideas, but playing with them. So this is a much later painting by Van Gogh of his bedroom, in southern

France. And it more or less follows a one point perspective. But he plays with it a bit. He does not force, first of all, the objects are not all oriented in the same way.

But he is also generally trying to capture something about the emotion of being in that space. And it is not a very rigid space like the de Vries. He does not want to create a space obviously that feels like an instruction manual. It is his bedroom and there are a lot of emotions attached.

You know even his use of straight lines he does not strictly use straight lines to represent straight lines in space. So he is bending the rules a little bit.

**(Refer Slide Time: 15:18)**



And other artists, this is also just a little after Van Gogh, played with the rules by juxtaposing multiple viewpoints. So de Chirico, for example, each individual object will carefully follow the rules of perspective. This line and this line are converging to a vanishing point somewhere here. And there is a horizon line somewhere here.

But then this other building is converging to some fully different vanishing point, which is not even on the horizon line. And this kind of trailer here, it is not even drawn in perspective. Or if it is, maybe the vanishing point is somehow coming in front. So he is bending the rules quite a bit in the individual objects and then juxtaposing them. So you are having multiple viewpoints in one painting.

So these were just a couple of ways that artists played with the rules of perspective and took them in without necessarily following them to a tee.

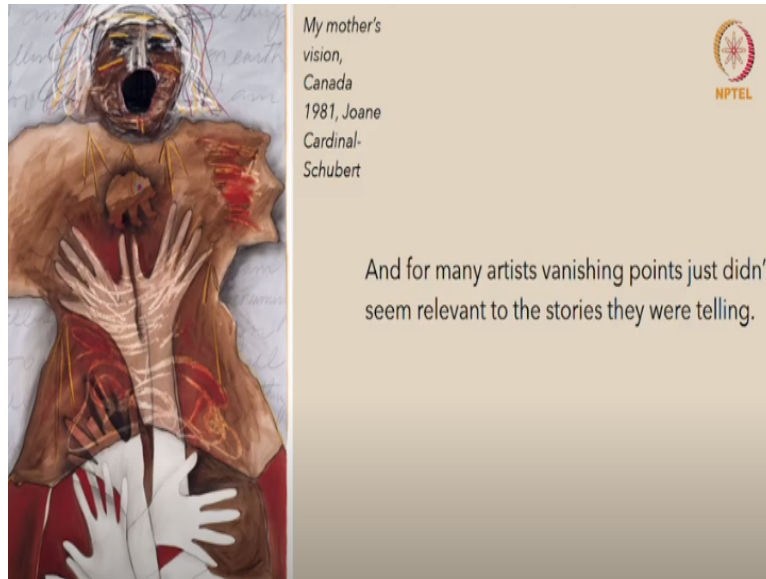
**(Refer Slide Time: 16:21)**



Then there were other artists who fully subverted the rules. So for example, David Hockney did a series of paintings, in which he just reversed the rules of perspective so that parallel lines do not, will converge, but they converge to the place to the point where the viewer is viewing the painting from. They converge towards the viewer, instead of away.

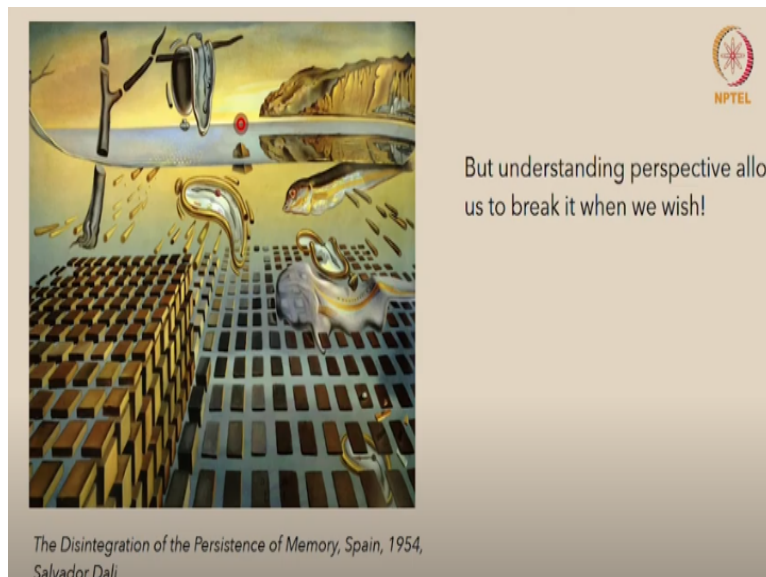
So it is something that he just wanted to try flipping the rules and seeing what resulted. And the paintings that resulted are actually very interesting. They are taking us out of the way we ordinarily see the world, and somehow pulling us into this other world in a very different way. So there is definitely a lot of liveliness that one can create, by changing rules of perspective, once they are understood.

**(Refer Slide Time: 17:16)**



And, of course for many artists, vanishing points just maybe did not seem relevant at all to the stories they were telling. This is a Canadian artist, indigenous artist, who even here though, there arguably there is some perspective, some foreshortening of the figure, that is happening. But clearly perspective does not have to be the only way in which you or an artist approaches art.

**(Refer Slide Time: 17:46)**

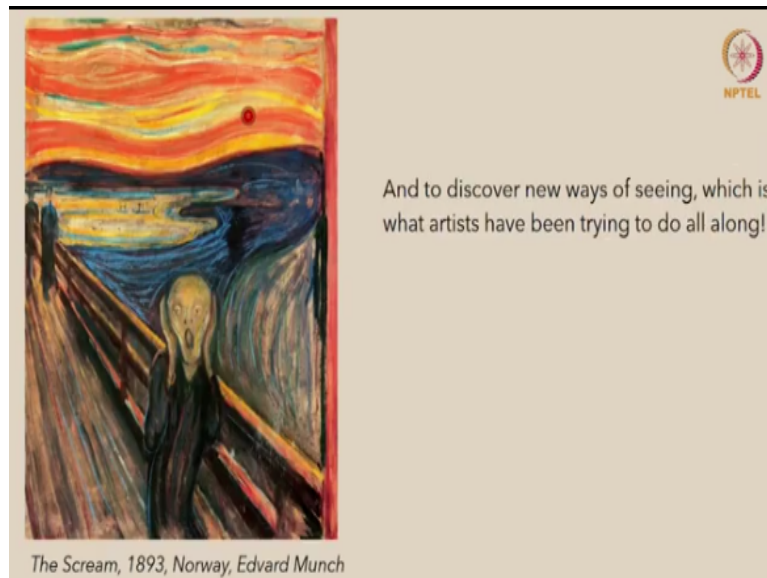


And in any case though, understanding perspective and understanding the rules allow us to break them when we wish. And here is a painting known as the disintegration of the persistence of memory by Salvador Dali. This is also from the 1900s, 1954. So Dali actually uses perspective almost perfectly. He is actually being very careful and particular about fixing his vanishing points and making sure that he is using them

correctly, that objects, that families of parallel lines, indeed converge to the vanishing point he set for them. But within that framework, he fully departs from reality.

So he finds a way to actually follow perspective, but break from reality in terms of the subject matter.

**(Refer Slide Time: 18:40)**

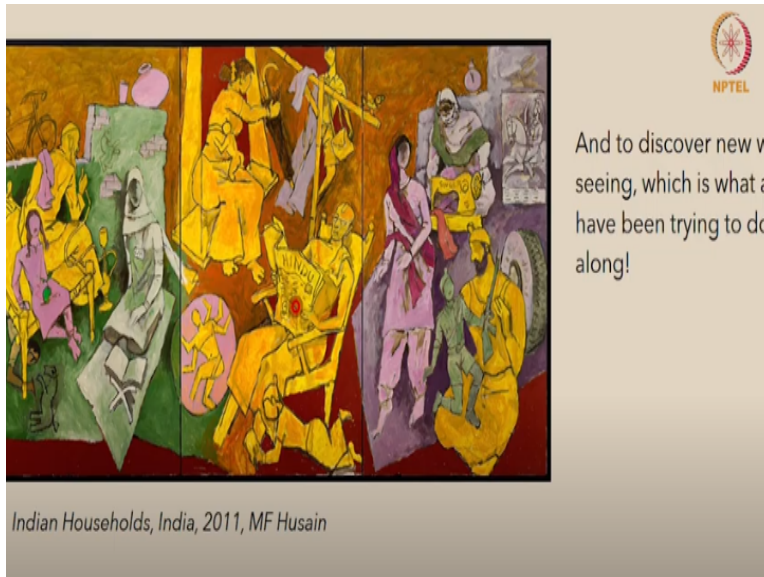


And in a similar way, Edvard Munch, famously with his painting *The Scream*, in 1893, also more or less followed the rules of linear perspective. But in this case, he is exploring a very new and vibrant style of art.

But in which, this you know simplicity of that one vanishing point, really helps to take us into the psychological state of this character and this painting in which somehow that one vanishing point is really pulling everything, pulling all the colors, pulling not just the lines in space, but even the colors and even the kind of emotional atmosphere into one spot and kind of pushing this character out into the foreground and helping us identify with it maybe.

So in particular perspective can really help us discover new ways of seeing and that is something that artists have been trying to do all along.

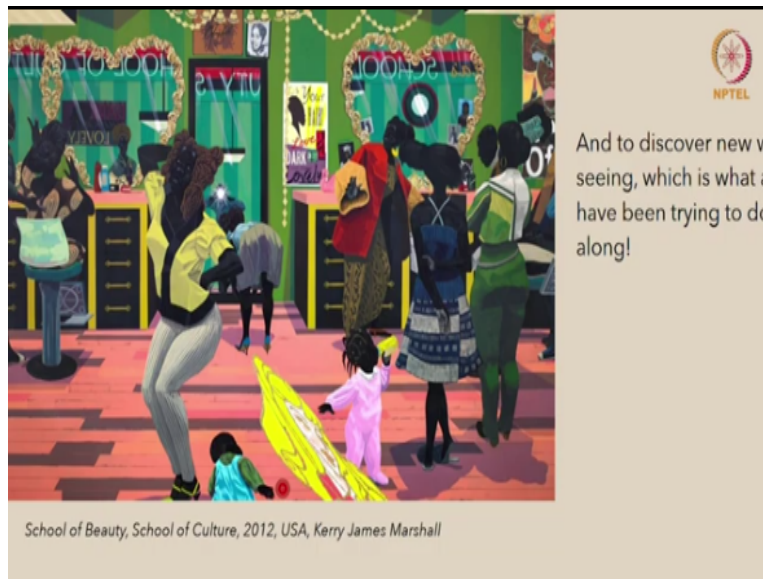
**(Refer Slide Time: 19:54)**



So as another example, this is a much more recent painting by the Indian painter, MF Husain, one of his last paintings actually, part of a series of triptychs, of triple paintings that he did. And this is called Indian Households in which he is looking at three different Indian households, but kind of making them merge into one painting.

So he is using perspective, various different perspectives and juxtaposing them but to create three different settings in the same painting. And at the same time, he is making sure they do not become fully separate. So each painting bleeds into the other. But somehow the varying perspectives pull them apart. And we end up with three different Indian households from three different parts of India that are somehow occupying the same space. So that is another very interesting use of perspective.

**(Refer Slide Time: 20:53)**



And to discover new ways of seeing, which is what art has been trying to do along!

Another recent painting by Kerry James Marshall, is also using one point perspective in a fairly careful way. But there are a few things to notice here. One is that, because whenever we see a painting in perspective, there is a certain viewpoint that it pushes us into or enforces on us. Because the horizon line, remember, is at eye level of the viewer.

So here the eye level is fairly low down. So we are actually in the scene and seeing it from a fairly low angle. It is almost like we are sitting there in this beauty parlor. The painting is called School of Beauty, School of Culture. So it is a beauty parlor run by four black Americans. So it is bringing us into this very intimate space.

And at the same time, there is another interesting use of perspective here. I do not know if you can notice this element. This is just kind of floating there. It is almost like a hologram or a ghost image. And it almost feels like it has been just pasted onto the painting, except that these two kids both seem to be aware of it, nobody else does.

The kids are both looking at this, examining this strange floating object. And this object interestingly enough is, well it is hard to tell what it is, because it has been put in from a very different perspective. If we view the painting, if we were to take the painting and view it like this, then we could kind of see what this object is. And it is kind of a cartoon or caricature of a pretty white woman.

So it is kind of this standard of white beauty and represents white supremacy, which is kind of creeping in, in the form of this hologram. He is also making a very explicit allusion to a practice that existed after the renaissance in various paintings of hiding a skull, somewhere in your painting.

And after the Renaissance people started, some artists have done this by hiding it in an extreme perspective, exactly like this. So by viewing your painting from a strange angle, you will see this skull, which is a reminder of your impending death and mortality. So he is very much alluding to that when he adds this element into the picture.

By using the rules of perspective, he has basically extended this image out. So it is not really identifiable, unless you view the painting from a very specific angle. So that is a very different use of perspective within this painting, which is anyway using linear perspective in a fairly interesting way.

**(Refer Slide Time: 24:09)**



I will just look at a couple more paintings that use perspective. So here is another painting from India in 1981, of a local train. And here, he may not be very clear how perspective is being used. But in a way, if you have ever traveled in a train, some

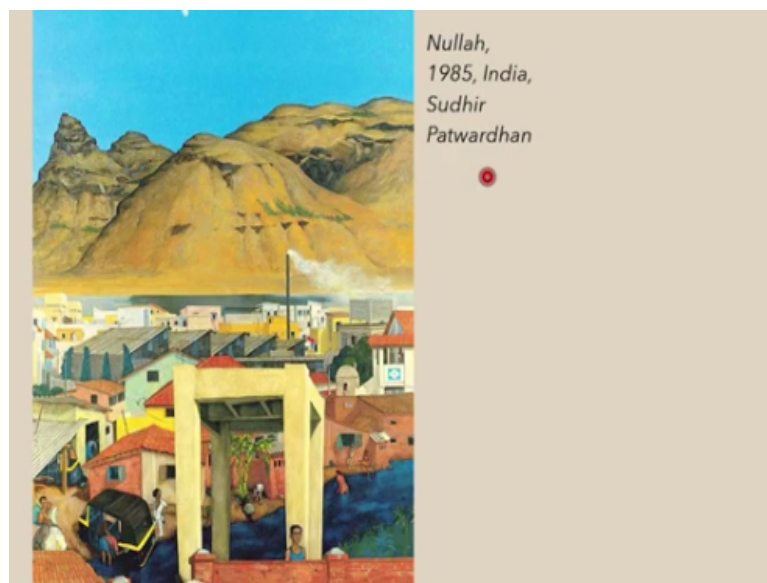


elements of this might feel familiar, because you are actually seeing various different sections.

Being in a train can be a disorienting experience visually. You are seeing many different fragmented pieces, which somehow come together. And he is attempting to capture that feeling I think through again juxtaposing slightly different perspectives. It is not really clear whether he is actually using different vanishing points or just getting the feel of that through different colors and through this kind of collage effect.

As a little exercise, you can also try and follow some of these points along and see where they lead you. See where the vanishing points are that they lead you to and what kind of effect that can create in the scene.

**(Refer Slide Time: 25:36)**



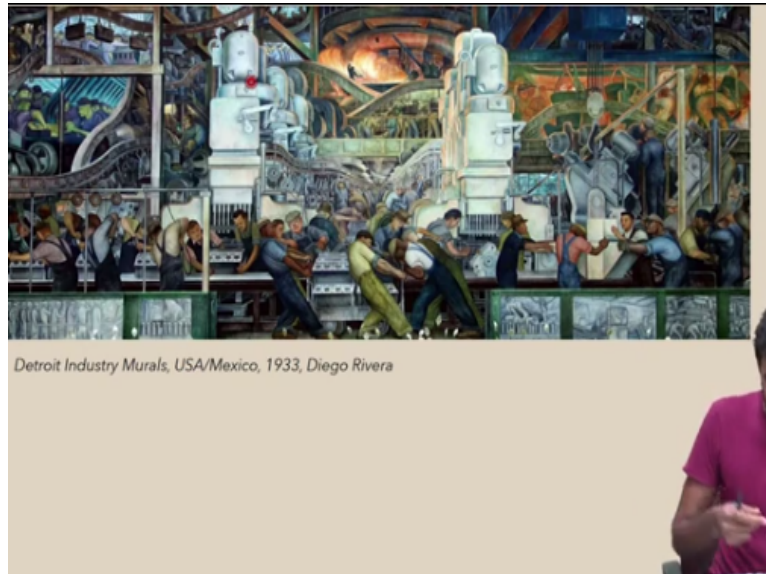
Finally, here is another picture from India. This is by Sudhir Patwardhan. And here he is much more explicitly juxtaposing different vanishing points, different viewpoints. There is no way that we can actually see this structure from below, while at the same time seeing this auto rickshaw from above.

But somehow doing that, and seeing this village, seeing it from within and from below, and then seeing it from above, and then seeing the mountains above that, and then the sky, together this effect of taking in so many different parts of this world at

once. It somehow does feel more like our experience of going through, walking through the streets, walking through a village or just walking around day to day.

So there is something about our way of seeing the world that is captured here, using perspective, which is not necessarily from a fixed viewpoint. In fact, departs from a fixed viewpoint. I find that really interesting as well.

**(Refer Slide Time: 26:49)**



So one final picture, which is from 1933. So I am jumping around in time quite a bit. This is by Diego Rivera. And this is known as one of his Detroit industry murals commissioned for this for the American city of Detroit. He is a Mexican painter, about the automobile industry, and the shop floors in the factories there. And this one again, perspective is used to stitch together many different aspects of the production process.

So you see there are workers all over this painting, even in these tiny areas here, who are engaged in various different parts of the production process. And from these large, the largest scale workers in the foreground, to these workers that are going back to this vanishing point here. And then there is the second floor and third floor.

But basically, using perspective, he managed to stitch together all of these workers and bring them into one setting. So although the factory itself in the shop floor is

really fragmented into many different types of work, and everybody is actually doing just one task as part of this big production process. Somehow this mural captures a lot of that, and somehow brings it back together.

So anyway, this is just a kind of quick tour of how artists in many different points in time and space have been using perspective since its discovery to explore new ways of seeing and representing the world.