So we've now drawn pictures of the interaction of a person jumping off a cart in both the ground frame and a reference frame moving with velocity, vc, which is the final speed of the cart.

These were pictures in the reference frame moving with vc, and these are the pictures-- momentum diagrams-- of the person and the cart in the ground frame.

Now, we would like to apply the momentum principle to solve for vp and vc.

We are given that the velocity of the person in the moving frame, u.

We'll treat this as a given quantity.

And we'll express the velocity, vc, and so we want to find vc and vp in terms of u and p and mc.

Now, we'll use the ground frame first, and our assumption here is that the person jumped horizontally and that there are no external forces in the horizontal direction.

So all of the vectors we've drawn are horizontal, and there's no external forces in the horizontal direction.

Then we know that the initial momentum of the system is equal to the final momentum of the system.

In our initial picture, nothing is moving.

And in our final picture, we have m cart v cart plus m person v person is 0.

Now, recall that we also showed that the velocity of the person in the ground frame is related to the velocity of the person in the moving frame by adding the relative velocity of the two frames.

The relative velocity of the two frames is the velocity of the cart, vc, so what we have is vc plus u.

So this is how vp is related to u.

And now, I can use this start equation to write it as 0 equals mc vc plus mp times vc plus u.

And by adding terms, I get that mc plus mp vc equals minus mpu.

Or the velocity of the cart is equal to minus mpu divided by mc plus mp.

Now that I have the velocity of the cart, I can just substitute that in here to find the velocity of the person, which, remember, was the velocity of the cart plus u.

So now, I've solved this problem in the ground frame.

Next, I'll do the same analysis in the moving frame.