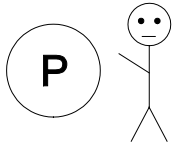


Why do mirrors reverse left and right, but not up and down?

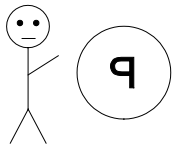
Tired of Sudoku puzzles? Try this one instead.

When you look in a mirror on the wall, you see your image reversed left to right, but not upside down. How then does the mirror know that it has to swap the image about a vertical axis, but not about a horizontal one?

Here's one person's answer.

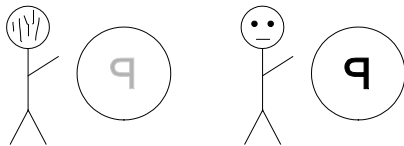


If the figure above were to look in a mirror, it would see...what? This is a pretty easy experiment to do, and most people would agree that it would be this.



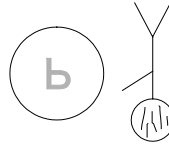
Has left and right been reversed? Yes, it has. But let's stop a moment and see how we arrived at this answer; there are two steps.

Step one is to turn the figure around so that it faces the other way—the same way we are looking. We can't see the P now because it's facing the other way. Step two is look in the mirror, which gives us our answer.

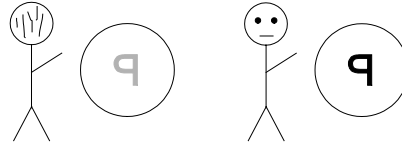


Notice that we selected to turn the figure around about a vertical axis. Asked to face the other way, not many people lunge forward and stand on their hands. But what if they did?

The first step would be:

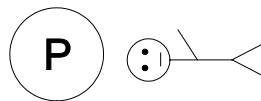


Then, rather surprised, we would ask the figure to stand up (rotate the figure so that it is upright); then look in the mirror.



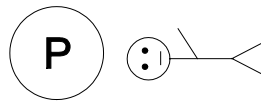
And the answer is the same.

Now, same question, what would the figure below see if you were to hold up a mirror?

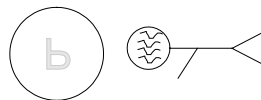


Don't cheat by turning the page sideways, just imagine yourself lying down and turning the figure facing around so it is looking in your direction.

Most readers will answer:



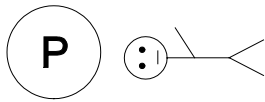
If you can't see how it could be this, imagine you are lying in bed facing the figure. Ask the figure to roll over so that it is facing the same way you are.



But now its left arm is underneath it and the P, which we can't see, is upside down. So ask it to swap up and down and (to be fair) turn the P back up the other way.



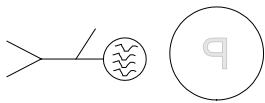
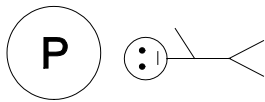
Look in the mirror.



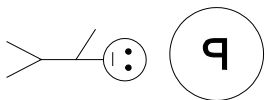
Has left and right been reversed? No, it hasn't.

Another way to get the answer is as follows.

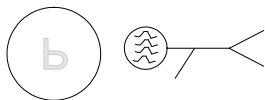
Pivot the figure about a vertical axis so it is facing the other way.



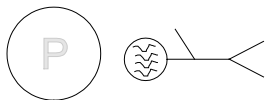
Look in the mirror.



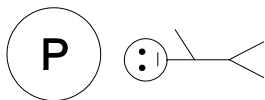
However, asked to face the other way when lying down, not many people swivel around so their feet are in the other person's face. So let's rotate the figure about a forward-backward axis (in the plane of the paper):



Swap up-and down because it can't lie on its arm:



And look in the mirror:



Again, the answer is the same as when the figure rolled over. Left and right have not been reversed.

To see ourselves as others see us, we need to turn ourselves around and face the other way, a process that does swap left and right, but only if we happen to be standing up.

The problem we are dealing with here is that there are two ways of interpreting an image in a mirror. The first hypothesis is that the image is of "self" seen as others see us. The second hypothesis is that the image is of "other" facing us. Because our brains are not hardwired to deal with the unusual circumstance of facing a mirror, we don't instinctively perceive that *both* of these hypotheses are wrong.

What the mirror does is turn us around *without* swapping left and right. If you really believe that the mirror has swapped left and right, put your toothbrush on the bathroom counter on your left. Does it appear in the mirror on the right? No it doesn't. Same goes for up and down. When we roll over, we quickly reverse the up-down swap by swapping arms, but we don't do that when standing up, so it looks like the mirror did something it didn't do.

And if you are still not convinced, go find a piece of transparent plastic, and with a felt pen write a large "6" on it. Now, hold the "6" on the plastic in front of you and simultaneously look at its image in the mirror. What do you see? Well, if you're doing it right, surprise, surprise. You see both like a "6", neither reversed left to right, nor upside down. This business about left-right reversal is, you see, all in the mind.

What the mirror does is reverse forward and backward, nothing more. Next time you see a budgerigar chatting to a mirror; be sympathetic. It has the same hardwired logic that our brains do, just no capacity or inclination to (painfully) run the software logic to correct it.